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AUTHOR(S):

KATO, Makoto; MATSUMOTO, Masamichi; KATO, Tôru

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Terrestrial Malacofauna of Shizuoka Prefecture in Japan: Biogeography and Guild Structure

Makoto KATO, Masamichi MATSUMOTO and Tôru KATO

ABSTRACT One hundred and eleven species of terrestrial molluscs belonging to six Prosobranch and 19 Pulmonate families were recorded from Shizuoka Prefecuture situated on the southern coast of central Honshû, Japan, and the distribution pattern and guild structure were analyzed. The malacofauna had altitudinal and longitudinal gradients; the former was related with ecological environments and the latter arose from geological heterogeneity, connection of the direction of spreading with various barriers for dispersal, and geohistory of isolation and speciation. Certain character displacement patterns were discerned in the shell volume of sympatric Clausiliid species. The effect of interspecific interaction on guild structure was discussed.

KEY WORDS land snail/ Shizuoka Prefecture/ biogeography/ guild structure

Introduction

On account of low potential for dispersal, terrestrial molluscs involve characteristic evolutionary and biogeographical pattern contrasting with other organisms with high potential for dispersal (Pearke, 1978; Solem, 1984). The distribution of a molluscan species is sometimes not limited by physiological or ecological factors but by topographical factors. In certaion species, on the other hand, the range may be expanding. Thus, the guild structure of molluscs has relations with not only ecological environments such as characters of litter and soil (Cameron, 1986), area and isolation of habitat, vegetation structure, habitat diversity, habitat heterogeneity (Andrê, 1984; Nilsson et al, 1988), predation pressure (Jones *et al.*, 1977) and interspecific competition (Cameron & Carter, 1979), but also historical events such as geohistory of barriers for dispersal (Pearke, 1978), environmental changes (Verdcourt, 1984) and habitat destruction by man (Evans, 1968).

In order to clarify the guild structure and evolutionary pattern of terrestrial molluscs in temperate forest of Japan, we investigated the local distribution pattern of molluscs in Shizuoka Prefecture located in the central part of Honshû Island. Samplings of the mollusc fauna were made at geographically and ecologically various sites, and the distribution patterns of respective species were surveyed.

Study Area and Method

Shizuoka Prefecture located along the central part of southern coast in Honshû Island is composed of three topographically and geohistorically differnt regions: the Akaishi Range, Mt. Fuji and Izu Peninsula (Fig. 1). The main part of the Akaishi Range is composed of Mesosoic sedimentary rocks which are metamorphosed by folding and the coastal subregion is composed of Tertiary and Quaternary sedimentary

rocks. There are some limestone beds in the south-west subregion. In contrast, Mt. Fuji and Izu Peninsula subregions are composed of volcanic rocks. Mt. Fuji is a dormant volcano which emerged in Tertiary period, and the latest eruption was in 1707. The coasts of Izu Peninsula are rock beaches whereas other shorelines are fringed with sandy beaches.

Climate strikingly varies along altitude from 0 to 3776 m, and the following vegetational zones can be discriminated: *Castanopsis*-dominated evergreen forest (0 - 800 m), cool temperate deciduous forest (800 - 1500 m), subalpine coniferous forest (1500 - 2500 m) and alpine zone. Due to development of plains and deforestation and afforestation of mountains, primary vegetations are distributed only scatteringly.

At 296 sites including geographically and ecologically various habitats (Fig. 1), molluscs were hand collected paying particular attention to logs, rocks, tree trunks and interstitial zone of gravels. Minute molluscs were also picked up from sampled leaf litter, or collected by beating trees and shrubs with insect-collecting nets. The distribution records were arranged into vertical meshes partitioned by altitudinal and longitudinal axes (Fig. 2), and two sets of data matrices were obtained. The observations of the first data matrix are 23 meshes and the variables are inhabitance of 116 molluscan taxa (1, present; 0, absent). The observations of the second data matrix

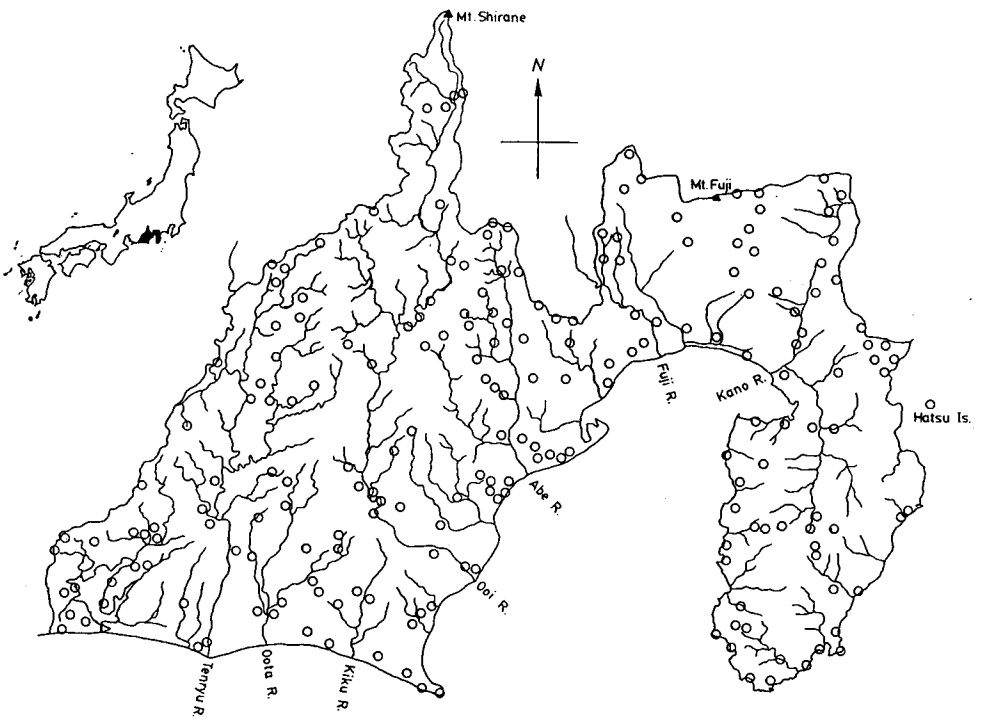

Fig. 1. Location of Shizuoka Prefecture in Japan and a map of the sampling sites.

are 116 molluscan taxa and the variables are distributions in each of 23 meshes (1, present; 0, absent). Guild structure of malacofauna and distribution pattern of the molluscs were analyzed using these data matrices.

To elucidate the process of formation of extant distribution, we focused our attention on Clausiliidae. The shell height and the shell volume of sympatric and allopatric Clausiliid species were measured with a caliper and a measuring cylinder, respectively.

A List of Terrestrial Molluscs in Shizuoka Prefecture

This list includes all species collected in Shizuoka prefecture, including 3 species cited from references. We basically followed the system of Minato (1988) excluding some parts. The localities are recorded after abbreviations of administrative districts (Fig. 3), and the altitudes are added in parentheses. The abbreviations are as

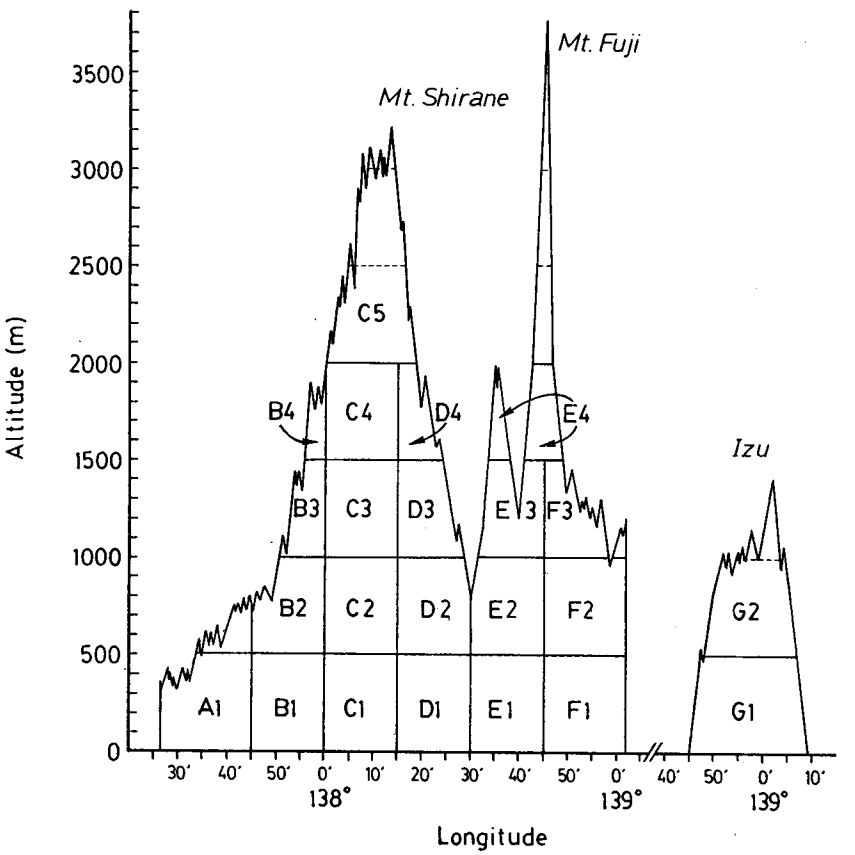

Fig. 2. Vertical meshes in Shizuoka Prefecture. Twenty-three meshes were partitioned by altitudinal and longitudinal axes. Izu Peninsula is separated from the mainland in this graph whereas they are connected.

follows: AT, Atami-shi; FE, Fujieda-shi; FG, Fuji-gun; FJ, Fuji-shi; FM, Fujinomiya-shi; GT, Gotenba-shi; HB, Haibara-gun; HK, Hamakita-shi; HM, Hamamatsu-shi; HN, Hamana-gun, IH, Ihara-gun; IG, Iwata-gun; IN, Inasa-gun; IT, Itô-shi; IW, Iwata-shi; KK, Kakegawa-shi; KM, Kamo-gun; KS, Kosai-shi; MI, Mishima-shi; NZ, Numazu-shi; OG, Ogasa-gun; SD, Shida-gun; SI, Shimada-shi; SK, Shimoda-shi; SN, Susono-shi; ST, Sunto-gun, SY, Syûchi-gun; SZ, Shimizu-shi; TR, Tenryû-shi; TG, Tagata-gun; YZ, Yaizu-shi. These districts of localities are listed in order of longitude (from west to east). Distributions of Clausiliid and *Euhadra* specise are shown as maps (Figs. 4-12).

Subclass PROSOBRANCHIA
Order Archaeogastropoda
Superfamily Hydrocenacea

Family Hydrocenidae

Georissa japonica PILSBRY, 1900

TR: Aoya (160 m); IG: Sakuma-cho, Kamihirayama, Nagoo (120 m); Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Ari-

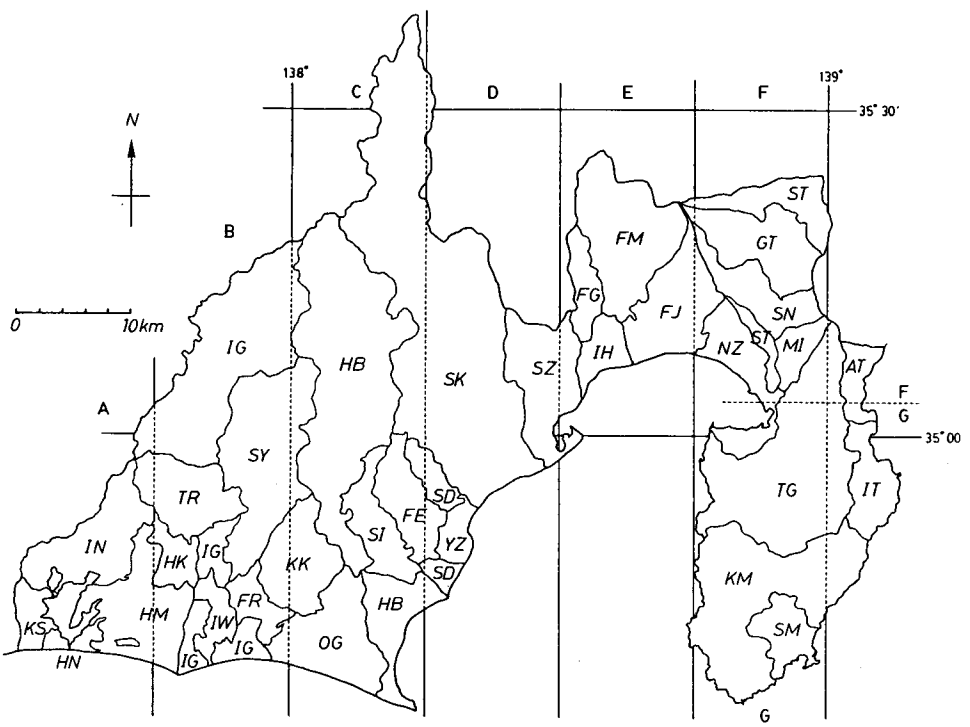

Fig. 3. Map of administrative districts of Shizuoka Prefecture. Refer to the text for abbreviations of the districts.

moto (500 m); Tatsuyama-mura, Sejiri, Hasaka-yama (300 m)

Georissa shikokuensis AMANO, 1939
IN: Mikkabi-cho Tadaki (60 m); Inasa-cho, Mitake (280 m); Inasa-cho, Tokka (200 m); Inasa-cho, Mishishimura, Nakamura (70 m); Inasa-cho, Higashishimura, (100 m); Inasa-cho, Tanishita (60 m); HM: Washizawacho (120 m); Takizawa (200 m); HK: Negata, Gansui-ji (60 m); TR: Aoya (160 m)

Superfamily Neritacea

Family Helicinidae

Waldemaria japonica (A. ADAMS, 1861)
IG: Sakuma-cho, Ryûtô-san (1250 m); HB: Nakakawane-cho, Sobatsubu-yama (1350 m); SK: Ikawa, Ikawa-tôge (1600 m); Umegashima, Abe-tôge (1450 m); FM: Fuji-san, Shiratsuka-rindô; ST: Oyama-cho, Fuji-san, Subashiri-tozandô (1700 m); GT: Fuji-san north of Katabokkuri-yama (1400 m); SN: Jûrigi (900 m)

Order Mesogastropoda
Superfamily Cyclophoracea

Family Cyclophoridae

Japonia sadoensis PILSBRY & HIRASE, 1903
IN: Inasa-cho, Higashishimura (100 m); Inasa-cho, Higashikurumegishinden (100 m); IG: Sakuma-cho, Kamihirayama Nagoo (120 m); SK: Umegashima, Magosajima, Ippukutôge (1100 m); Okusenmata (670 m); Do, Shirasawa (320 m); Nagakuma, Nunomakizawa (250 m); Ookuzure (10 m); Sunpujô (60 m); Utsunoya (100 m); FG: Shibakawacho, Kamiinako, Ochiai (260 m); FM: Nebara (1000 m); FJ: Ashitaka-yama, Sudo-gawa (750 m); KM: Kamo-mura, Nishina-tôge (600 m); Kawazu-cho, Hama (10 m)

Japonia katorii MINATO, 1985
HM: Higashikurumegi-shinden (100 m)

Cyclophorus herklotsi MARTENS, 1860
IN: Mikkabi-cho, Okuhirayama (180 m); IN: Inasa-cho, Tokka (200 m); Inasa-cho, Mitake (280 m); Inasa-cho, Tabata, Ryûgashi-dô (80 m); Inasa-cho, Higashishimura (100 m); TR: Aoya (160 m); HM: Washizawacho (120 m); IW: Teratani (100 m); SY: Haruno-cho, Moriyama (300 m); KK: Takinoya (100 m); OG: Kikugawa-cho, Rokugo (40 m); SI: Chiba-san (360 m); SD: Okabe-cho, Megurizawa (150 m); SK: Kuzureno, Yakusa (620 m); Kuchisakamoto (520 m); Ashikubo, Sikichi (140 m); Ashikubo, Yazawa (170 m); Utsunoya (100 m); Ookuzure (40 m); Inuma, (600 m); SZ: Shishihara (240 m); Taru-tôge (400 m); IH: Yui-cho, Satta-tôge (200 m); Hamaishi-dake (300 m); Fujikawa-cho, Saginota (300 m); FG: Shibakawa-cho, Kamiinako, Iriyama (350 m); Shiba-

kawa-cho, Kamiinako, Ochiai (260 m); Shibakawa-cho, Kamiinako, Miyaji (160 m)

Nakadaella micron (PILSBRY, 1900)
KS: Utsu-yama (10 m); IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Okuyama Kuma (180 m); Inasa-cho, Tabata, Ryûgashi-dô (80 m); Hosoe-cho, Ime (10 m); IG: Misakubo-cho, Aokuzure-tôge (1000 m); Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); Misakubo-cho, Kadoketa (550 m); Misakubo-cho, Keta-gawa, Toyooka Dam (450 m); Tatusyama-mura, Ichinose (320 m); HK: Negata, Gansui-ji (60 m); SY: Nori-machi, Funanba (200 m); KK: Haramiishi (100 m); Oono, Nakagumi (80 m); OG: Kikugawa-cho, Rokugô (40 m); HB: Honkawane-cho, Fujikawa (400 m); Honkawane-cho, Fujishiro (700 m); Kawane-cho, Oowada (160 m); Kanaya-cho, Fukuyo, Hakko-gawa (100 m) ; SD: Okabe-cho, Megurizawa (150 m); SK: Kanzô (650 m); Umegashima, Ooya-kuzure (1200 m); Hirano, Mafuji-yama (900 m); Udo-san (50 m); FM: Fumoto (1050 m); Inogashira (720 m); Tenshôkyôsha (1000 m); ST: Oyama-cho, Shimoisshiki (420 m); Oyama-cho, Mikuni-yama (1100 m); GT: Ninooka Ninooka-jinja (500 m); SN: Chabatake (300 m); TG; Shuzenji-cho, Shuzenji (200 m); Amagiyugashima-cho, Amagi-tôge (820 m); KM: Kawazu-cho, west of Noborio (550 m); IT: Akazawa (450 m)

Family Alycaeidae

Chamalycaeus nipponensis (REINHARDT, 1877)
IN: Inasa-cho, Higashikurumegishinden (100 m); Inasa-cho, Higashikurumegi (120 m); IG: Sakuma-cho, Sakuma Dam (260 m); Sakuma-cho, Kamihirayama, Nagoo (120 m); Misakubo-cho, Aokuzure-tôge (1000 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m); Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Misakubo Dam (530 m); Misakubo-cho, Kurohôshi-dake Tôkô-one (1530 m); Tastuyama-mura, Ichinose (320 m); HM: Kanzanji (30 m); SY: Haruno-cho, Kyômaru-zawa (450 m); Haruno-cho, Hirano (150 m); KK: Takinoya (100 m); HB: Sagara-cho, Ogami-yama (80 m); SD: Okabe-cho, Megurizawa (150 m); SK: Do, Shirasawa (320 m); Ashikubo, Kurishima (150 m); Shizuhata-yama (110 m); Utsunoya (100 m); Kitanumagami Hirayama (130 m); Udo-san (50 m); Furuyado (30 m); Kunô (10 m); SZ: Tashiro-tôge (750 m); Taru-tôge (400 m); FG: Shibakawa-cho, Kamiinako, Iriyama (350 m); FM: Fumoto (1050 m); Myôjô-san (180 m); ST: Oyama-cho, Suganuma (360 m); Oyama-cho, Mikuni-yama (1100 m); Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa (520 m); NZ: Oooka, Kise-gawa (10 m); Kanuki-yama (100 m); SN: Jûrigi (800 m); TG: Kannami-cho, Hirai (50 m); Heta-mura, Heta, Mihama-zaki (5 m); Shuzenji-cho, Shuzenji (200 m); Makaizu-cho, Shimoshiraiwa (100 m); AT: Midorigaokacho (200 m); IT: Ukiyama (50 m)

Family Diplommatinidae

Palaina pusilla (MARTENS, 1877)
KS: Shirasuka, Shiomizaka (10 m); Bôze (60 m); Utsu-yama (10 m); IN: Mikkabi-cho,

Tadaki (60 m); Inasa-cho, Tokka (200 m); Inasa-cho, Tabata, Ryûgashi-dô (80 m); Hosoe-cho, Ime (10 m); Misakubo-cho, Aokuzure-tôge (1080 m); Misakubo-cho, Shirakuragawa (950 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m); Tatsuyama-mura, Ichinose (320 m); HM: Washizawacho (120 m); SY: Mori-machi, Funanba (200 m); OG: Oosuka-cho, Oobuchi (10 m); Kikugawa-cho, Rokugo (40 m); SD: Okabe-cho, Megurizawa (150 m); Okabe-cho, Takakusa-yama (500 m); SK: Do, Shirasawa (320 m); Ashikubo, Yazawa (130 m); Nagakuma, Nunomaki-zawa (250 m); Inuma, Hirata (600 m); Umegashima, Magosajima, Ippuku-tôge (1100 m); Hirano, Mafuji-yama (900 m); Ooya (50 m); SZ: Tashiro-tôge (750 m); Itaizawa (200 m); Yoshiwara (240 m); Taru-tôge (400 m); IH: Fujikawa-cho, Kitamatsuno, Horinouchi (80 m); Fujikawa-cho, Saginota (300 m); FM: Nebara (1000 m); Inogashira (720 m); Fujioka (900 m); Fuji-san, Tenshôkyôsha (1000 m); ST: Oyama-cho, Fuji-san, Subashiri-tozandô (1350 m), Oyama-cho, Suganuma (360 m); Oyama-cho, Shimoisshiki (420 m); Oyama-cho, Mikuni-yama (1100 m); Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa; GT: Fuji-san, Katabokkuri-yama (1400 m); Fuji-san, Tarobo (1300 m); Ninooka, Ninooka-jinja (500 m); SN: Jûrigi (900 m); Kojiri-tôge (820 m); NZ: Chabatake (300 m); Oooka, Kisegawa (10 m); TG: Kannami-cho, Yugawara-tôge (800 m); Knnami-cho, Karuizawa (350 m); Shuzenji-cho, Shuzenji (200 m); Amagiyugashima-cho, Toi-tôge (580 m); Kayano (480 m); KM: Nishiizu-cho, Ootago (20 m); Minamiizu-machi, Iruma (10 m); Kawazu-cho, west of Noborio (550 m); Kawazu-cho, Mine (100 m); SM: Shirahama (10 m); IT: Ukiyama (50 m); Akazawa (450 m)

Diplommatina labiosa MARTENS, 1877

KS: Bôse (60 m); IN: Inasa-cho, Tokka (200 m); Inasa-cho, Tabata, Ryûgashi-dô (80 m); Nishishimura, Nakamura (70 m); HM: Washizawa-cho (120 m); HK: Negata, Gansuiji (100 m); IG: Sakuma-cho, Ryûtô-san (1250 m); Kamihirayama, Nagoo (120 m); Misakubo-cho, Shirakura-gawa (950 m); Aokuzure-tôge (1080 m); Misakubo-cho, Arimoto (500 m); Yamazumi, Shiraiwa-zawa (1050 m); Keta-gawa, Toyooka Dam; (450 m); Tochû-gawa, Hikage-zawa (1010 m); Kôchi-gawa, Nuno-taki (420 m); Kadoketa (500 m); Tatsuyama-mura, Ichinose (320 m); SY: Haruno-cho, Toyooka, Myôjinkyô (400 m); Mori-machi, Funaba (200 m); HR: Honkawane-cho, Fujikawa (400 m); Honkawane-cho, Umeji, Kanzô (500 m); Nakakawane-cho, Sobatsubu-yama (1350 m); SI: Minari, Kawaguchi (180 m); SK: Ikawa, Ikawa-tôge (1600 m); Umegashima, Abe-tôge (1450 m); Magosajima, Ippuku-tôge (1100 m); Okusenmata (670 m); Nagakuma, Nunomaki-zawa (250 m); Do, Shirasawa (320 m); FM: Nebara (1000 m); Fuji-san, Shiratsuka-rindô (1150 m); Fuji-san, Tenshôkyôsha (1000 m); Fumoto (1050 m); Chôjaga-take (860 m); ST: Oyama-cho, Mikuni-yama (1100 m); GT: Fuji-san, north of Katabuta-yama (1400 m); SN: Jûrigi (900 m); TG: Kannami-cho, south of Yugawara-tôge (800 m);

Diplommatina uzenensis PILSBRY, 1900

KS: Shirasuka, Shiomizaka (10 m); IN: Inasa-cho, Shihôjô (160 m); Inasa-cho, Higashi-

kurumegi (120 m); Higashikurumegi-shinden (100 m); TR: Kannon-yama (500 m); SY: Haruno-cho, Kyômaru-zawa (450 m); SK: Umegashima, Abe-tôge (1450 m); Do, Shirasawa (320 m); SZ: Tashiro-tôge (750 m); FM: Nebara (1000 m); Fuji-san Tenshôkyôsha (1000 m); ST: Oyama-cho, Mikuni-yama (1100 m); SN: Jûrigi (860 m); TG: Kannami-cho, south of Yugawara-tôge (800 m); IT: Ukiyama (50 m)

Diplommatina oyamai Habe, 1943
SN: Chabatake (300 m); TG: Amagiyugashima-cho, Amagi-tôge (820 m); IT: Ukiyama (50 m)

Superfamily Assimineacea

Family Assimineidae

Paludinella japonica (PILSBRY, 1901)
NZ: Wakamatsu-zaki (20 m); KM: Kawazu-cho, Hama (10 m); SM: Tôji (5 m); Shirahama (10 m); AT: Hatsu-shima (10 m)

Paludirella kuzuuensis SUZUKI, 1937
IN: Mikkabi-cho, Tadaki (60 m); HM: Takizawa (200 m); HK: Negata, Gansuiji (60 m)

Subclass PULMONATA
Order Basommatophora
Superfamily Ellobiacea

Family Carychiidae

Carychium noduliferum REINHARDT, 1877
IG: Misakubo-cho, Aokuzure-tôge (1080 m); Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Toyooka Dam (450 m); SY: Haruno-cho, Kyômaru-zawa (450 m); SK: Do, Shirasawa (320 m); Okusenmata (670 m); Kuchisakamoto (550 m); Ashikubo, Yazawa (120 m); SZ: Tashiro-tôge (750 m); FG: Shibakawa-cho, Kamiinako, Iriyama (550 m); FM: Nebara (1000 m); Fumoto (1050 m), Inogashira (690 m); Tenshôkyôsha (1000 m); ST: Oyama-cho, Mikuni-yama (1100 m); Nagaizumi-cho, Ashitaka-yama Momozawa-gawa (520 m); SN: Jûrigi (900 m); TG: Kannami-cho, Yugawara-tôge (800 m); KM: Kamo-mura, Nishina-tôge (600 m)

Carychium nipponense PILSBRY & HIRASE, 1904
IN: Hosoe-cho, Ime (10 m); IG: Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); Misakubo-cho, Tochû-gawa, Hikage-zawa (1100 m); Misakubo-cho, Kadoketa (700 m); Sakuma-cho, Sakuma Dam (550 m); SK: Kanzô (550 m); Ooya-kuzure (1200 m); Ooya (50 m); IH: Fujikawa-cho, Kitamatsuno, Horinouchi (80 m); FM: Nebara (1000 m); Fujioka (900 m); ST: Oyama-cho, Subashiri-

tozando (1350 m, 1500 m) Oyama-cho, Shimoisshiki (420 m); Oyama-cho, Mikuniyama (1100 m); Nagaizumi-cho, Ashitaka-yama Momozawa-gawa (520 m); GT: Fujisan, Tarôbô (1300 m); SN: Jûrigi (900 m); NZ: Oooka, Kise-gawa (10 m); TG:Kannami-cho, south of yugawara-tôge (800 m); KM: Kamo-mura, Nishina-tôge (600 m); Matsuzaki-cho, Jaishi-tôge (300 m); Minamiizu-cho, Irôzaki (20 m); AT: Midorigaoka-cho (220 m); IT: Akazawa (450 m)

Order Stylommatophora
Suborder Orthurethra
Superfamily Pupillacea

Family Pyramidulidae

Pyramidula conica PILSBRY & HIRASE, 1902
IG: Misakubo-cho, Sirakura-gawa (950 m)

Family Vertiginidae

Vertigo eogea PILSBRY, 1919
NZ: Ukishima-numa (2 m)

Vertigo hirasei PILSBRY, 1901
IG: Misakubo-cho, Shirakura-gawa (950 m)

Vertigo japonica PILSBRY & HIRASE, 1904
IG; Misakubo-cho, Shirakura-gawa (950 m)

Family Chondrinidae

Gastrocopta armigerella (REINHARDT, 1877)
HB: Omaezaki-cho, Omaezaki (3 m); SK: Takamatsu (10 m); FJ: Suzukawa, (20 m); TG: Heta, Mihama-zaki (5 m); SM: Tôji (5 m); Shirahama (10 m)

Bensonella plicidens (BENSON, 1849)
IN: Inasa-cho, Mitake (280 m); HM: Takizawa (200 m); TR: Aoya (160 m)

Family Acanthinulidae

Pupisoma harpula REINHARDT, 1886
TR: Aoya (160 m); HB: Kawane-cho, Shiomoto (180 m); SM: Tôji (5 m); Shirahama (10 m)

Parazoogenetes orcula (BENSON, 1850)
IN: Inasa-cho, Mitake (280 m); TR: Aoya (160 m), KK: Oono, Nakagumi (80 m); FM: Nebara (1000 m)

Superfamily Partulacea

Family Enidae

Mirus reinianus (KOBELT, 1875)

IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Mitake (280 m); Inasa-cho, Takka (200 m); Inasa-cho, Tanishita (60 m); Inasa-cho, Higashishimura (90 m); HM: Takizawa (200 m); Washizawa-cho (120 m); HK: Negata, Gansui-ji (60 m); IG: Misakubo-cho, Yamazumi, Siraiwa-zawa (1100 m); IG: Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Misakubo Dam (550 m); TR: Aoya (160 m); FE: Kurata, Utôgeno-taki (420 m); HB: Sagara-cho, Megami-yama (80 m); Ogami-yama (40 m); SD: Okabe-cho, Megurizawa (150 m); SK: Kuchisakamoto (550 m); Ashikubo, Shikichi (150 m); Ashikubo, Kurishima (170 m); Ookuzure (10 m); Shizuhata-yama (150 m); SZ: Taru-tôge (400 m); FG; Shibakawa-cho, Kamiinako Ochiai (260 m); TG: Kannami-cho, South of Yugawara-tôge (800 m); Amagiyugashima-cho, Yugashima, Yoichizaka (240 m); Amagiyugashima-cho, Amagi-tôge (750 m), Kayano (480 m)

Suborder Mesurethra
Superfamily Clausiliacea

Family Clausiliidae

Zaptychopsis buschi (PFFEIFER, 1846) Fig. 4

SY: Haruno-cho, Ishikiri (300 m); HB: Omaezaki-cho, Omaezaki (20 m): Sagara-cho Megami-yama (80 m); YZ: Sakamoto (50 m); SK: Ikawa, Kanzô (550 m); Umegashima, Ooya-kuzure (1200 m); Umegashima, Abe-tôge (1450 m); Kuchisakamoto (550 m); Do, Shirasawa (320 m); Shizuhata-yama (110 m); Sunpujô (60 m); Funakawa (220 m); Sekibe (10 m); Mochimune (40 m); Ooya (20 m); KUnô (10 m); Kitanumagami, Hirayama (130 m); SZ: Taru-tôge (400 m); FM: Fuji-san, Shiratsuka-rindô (1330 m); Fuji-san, Tenshôkyôsha (1000 m); ST: Oyama-cho, Suganuma (360 m); Oyama-cho, Shimoisshiki (420 m); Oyama-cho, Mikuni-yama (1100 m): GT: Ninooka, Ninooka-jinja (500 m); NZ: Ootsuka (10 m); Oooka, Kise-gawa (10 m); TG: Kannami-cho, south of Yugawara-tôge (800 m); Kannami-cho, Karuizawa (350 m); Kannami-cho, Hirai (50 m); Toi-cho, Komezaki (40 m); Odoi (20 m); Koshimoda (40 m); Nakaizu-cho, Shimoshiraiwa (100 m); Nakaizu-cho, Hiekawa (100 m); KM: Kamo-mura, Nekko-tôge (920 m); Matsuzaki-cho, Yakiyama (60 m); Minamiizu-cho, Shimokamo (10 m); Kawazu-cho, Tanaka (10 m); SM: Kisami (20 m); AT: Midorigaokacho (220 m); Hatsu-shima (20 m)

Pinguiphaedusa pinguis platydera (MARTENS, 1876) Fig. 5

KS: Shirasuka, Siomizaka (10 m); Utsu-yama (10 m); Bôze (60 m); Oota (20 m); IN: Mikkabi-cho, Tadaki (60 m); HN: Arai-cho, Uchiyama (20 m); SI: Uami (250 m); Chiba-san (480 m); HB: Sagara-cho, Megami-yama (80 m); SK: Ikawa, Nikengoya to Senmai-dake (1800 m); Umegashima, Ooya-kuzure (1200 m); Shizuhata-yama (80 m); FM: Fuji-san, Tenshôkyôsha (1000 m); ST: Oyama-cho, Suganuma (360 m): GT: Ninooka,

Ninooka-jinja (500 m); SN; Jûrigi (900 m); Chabatake (300 m)

Pinguiphaedusa pinguis platyauchen (MARTENS, 1877) Fig. 5
IG: Misakubo-cho, Aokuzure-tôge (1080 m); Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m); SY: Haruno-cho, Ryûtô-san (1320 m); FR: Yamamoto (50 m); KK: Haranoya, Hatakama (50 m)

Pinguiphaedusa hakonensis (PILSBRY, 1900) Fig. 5
FM: Fuji-san Shiratsuka-rido (1330 m); Fuji-san, Tenshôkyôsha (1000 m); GT; Fuji-san, Katabokkuri-yama (1400 m); SN: Jûrigi (900 m); TG: Kannami-cho, Yugawara-tôge (800 m); Amagiyugashima-cho, Amagi-san (800 m); Amagiyugashima-cho, Kayano (480 m) IT: Akazawa (450 m)

Pinguiphaedusa expansilabris (BOETTGER, 1877) Fig. 5
IG: Misakubo-cho, Kadoketa-yama; HB: Honkawane-cho, Sobatsubu-yama (1350 m)

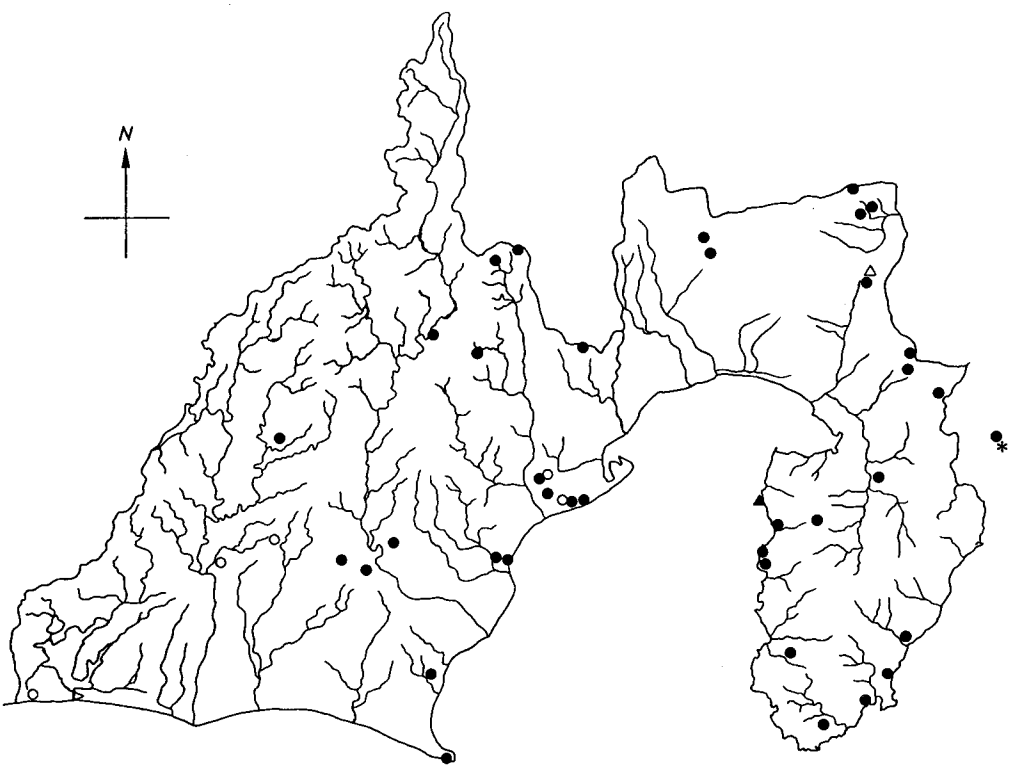

Fig. 4. Distributions of 5 clausiliid species: ●, *Zaptychopsis buschi*; ○, *Euphaedusa tau*; ▲, *Reinia variegata*; △, *Pictopaedusa euholostoma*; ✱, *Phaedusa sieboldii*.

Tyrannophaedusa aurantiaca erberi (MOELLENDORFF, 1885) Fig. 6
IN: Inasa-cho, Tabata, Ryûgashi-dô (80 m); IG: Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Arimoto (500 m); Kadoketa-yama (1250 m); SY: Mori-machi, Nishimata (100 m); SI: Uami (250 m)

Tyrannophaedusa surugensis (PILSBRY, 1902) Fig. 6
FM: Fuji-san, Tenshôkyôsha (1000 m); GT: Ninooka, Ninooka-jinja (500 m); TG: Kannami-cho, Yugawara-tôge (750 m); Amagiyugashima-cho, Kayano (480 m); KM: Kamo-mura, Arari (40 m); Minamiizu-cho, Irôzaki (10 m); SM: Kisami (20 m): IT: Akazawa (40 m)

Mundiphaedusa hosoyaka (PILSBRY, 1905) Fig. 7
IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Mitake (280 m); Inasa-cho, Tabata, Ryûgashi-dô (80 m); Inasa-cho, Nishishimura, Nakamura (70 m); Inasa-cho, Higashishimura (90 m); HM: Takizawa (200m); IG: Misakubo-cho, Shirakura-gawa (950 m); KK: Haranoya, Hatakama (50 m); Takinoya (100 m); Haramiishi (100 m); Higashiyama, Ookubo (220 m); SI: Ikumi, Futamata (280 m); Minari, Kawaguchi (180 m); Chiba-san (350 m);

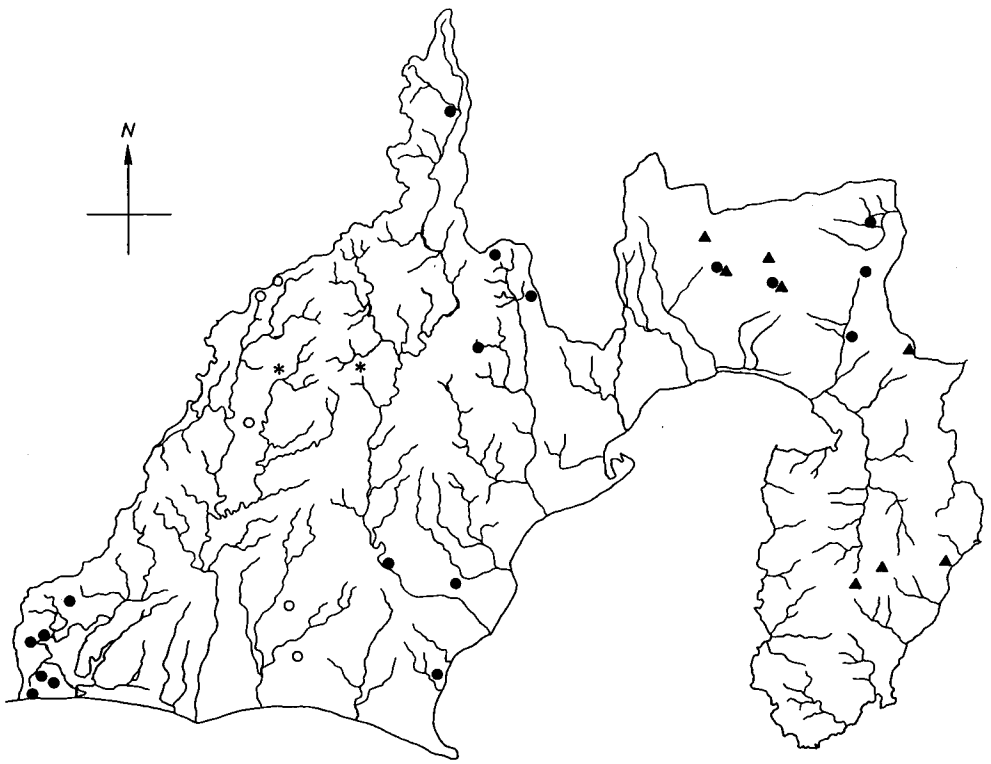

Fig. 5. Distributions of 3 clausiliid species: ●, *Pinguiphaedusa pinguis platydera*; ○, *P. p. platyauchen*; ▲, *P. hakonensis*; ✱, *P. expansilabris*.

HB: Sagara-cho, Megami-yama (80 m)

Mundiphaedusa rex (PILSBRY, 1905) Fig. 8
SK: Umegashima, Abe-tôge (1450 m); en route from Abe-tôge to Hakkôrei (1700 m); Okusenmata (670 m); Kuchisakamoto (550 m); SZ: Taru-tôge (400 m); FG: Sibakawa-cho, Kamiinako, Ochiai (260 m); FM: Chôjaga-take (860 m)

Mundiphaedusa dorcas (PILSBRY, 1902) Fig. 8
IG: Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m); HB: Nakakawane-cho, Sobatsu-bu-yama (1350 m); SK: Ikawa, Kanzô (650 m); Umegashima, Abe-tôge (1450 m); Mago-sajima, Ippuku-tôge (1100 m); Kuchisenmata (620 m); Kuchisakamoto (550 m); Ooma, Fukuyôzawa (700 m); Ashikubo, shikichi (170 m); FM: Fuji-san, Shiratsuka-rindô (1350 m); SN: Jûrigi (900 m); Kojiri-tôge (820 m)

Mundiphaedusa rhopalia (PILSBRY, 1902) Fig. 8
IN: Inasa-cho, Tokka (200 m); Inasa-cho, Tanishita (60 m) IG: Sakuma-cho, Ryûtô-san (1250 m); Misakubo-cho, Aokuzure-tôge (1080 m); Misakubo-cho, Yamazumi, Siraiwa-

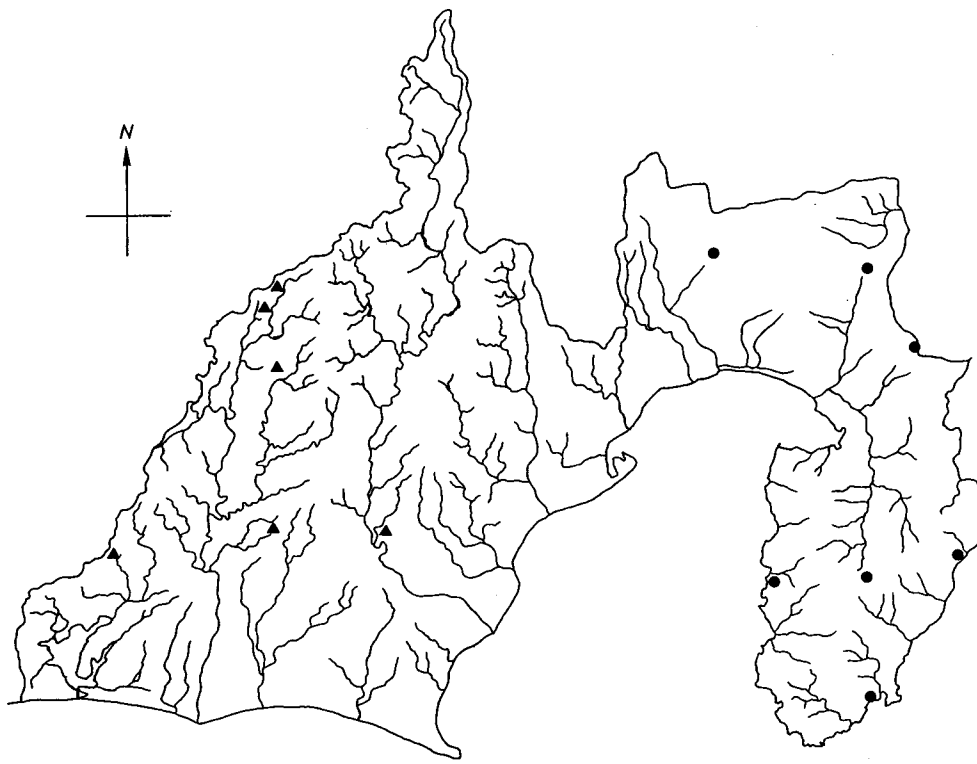

Fig. 6. Distributions of 2 clausiliid species: ●, *Tyrannophaedusa surugensis*; ▲, *T. aurantiaca erberi*.

zawa (1100 m); Misakubo-cho, Shirakura-gawa (950 m); Tatsuyama-mura, Ichinose (320 m); HK: Negata, Gansui-ji (100 m); TR: Aoya (160 m); SY: Morimachi, Funanba (200 m); OG: Kikugawa-cho, Rokugo (40 m); Kikugawa-cho, Shiraiwa (40 m); HB: Nakakawane-cho, Haibara-gawa (600 m); Nakakawane-cho, Sobatsubu-yama (1340 m); Kawane-cho, Oowada (160 m); Sagara-cho, Megami-yama (80 m); SI: Chiba-san (350 m); Chiba (200 m); SK: Kuchisakamoto (550 m); Negoya, Takizawa (30 m); IH: Yui-cho, Iriyama Morokizawa (100 m); FM: Fuji-san, Tenshôkyôsha (1000 m)

Mundiphaedusa sericina (MOELLENDORFF, 1882) Fig. 8
SK: Umegashima, Yunomori (590 m)

Neophaedusa iijimakuniakii (MINATO & HABE, 1983) Fig. 7
SK: Umegashima, en route from Magosajima to Ikawa-tôge (1100 m); Okusenmata (670 m); Kuchisakamoto (550 m); Ashikubo, Kurishima (170 m)
According to the chonchological and genital characters and ecological habits, this species is transfered from *Mundiphaedusa* to *Neophaedusa*.

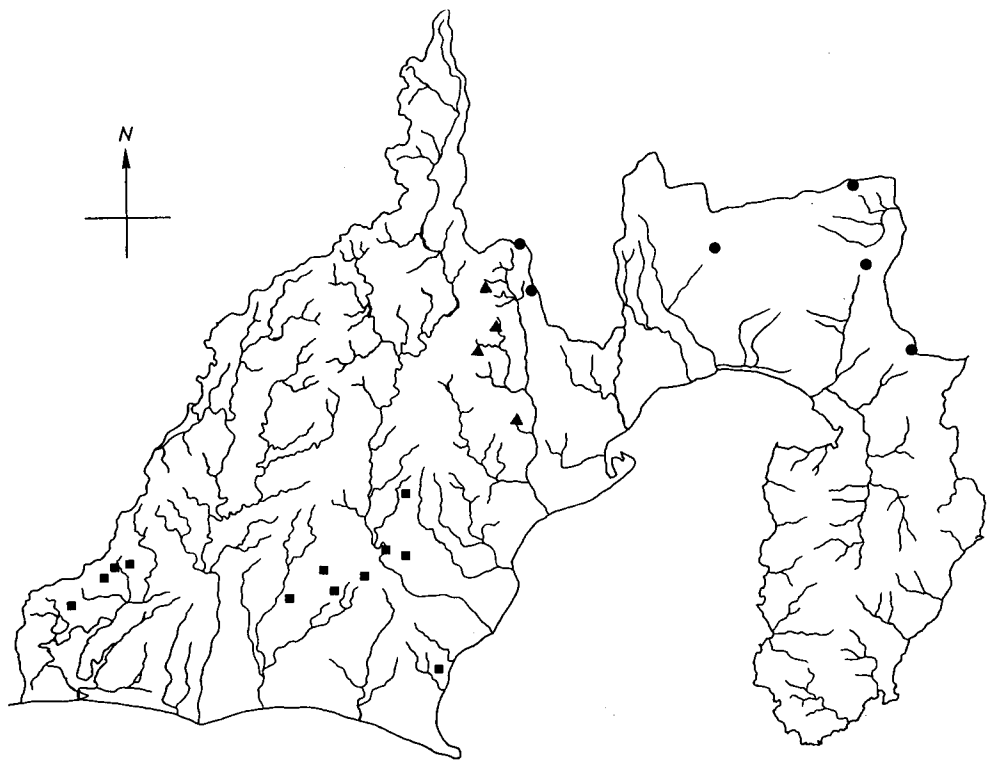

Fig. 7. Distributions of 3 clasuiliid species: ■, *Mundiphaedusa hosoyaka*; ▲, *Neophaedusa iijimakuniakii*; ●, *Vitriphaedusa micropeas*.

Vitriphaedusa micropeas (MOELLENDORFF, 1882) Fig. 7

SK: Umegashima, Abe-tôge (1450 m); Umegashima, Jûmai-san (1200 m); FM: fuji-san, Tenshôkyôsha (1000 m); ST: Oyama-cho, Mikuni-yama (1100 m); GT: Ninooka, Ninooka-jinja (500 m); TG: Kannami-cho, Yugawara-tôge (800 m)

Megalophaedusa martensii (MARTENS, 1860) Fig. 9

IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Tokka (200 m); Inasa-cho, Nishishimura, Nakamura (70 m); HM: Takizawa (200 m); IG: Sakuma-cho, Sakuma Dam (269 m); Sakuma-cho, Ryûtô-san (1250 m); IG: Misakubo-cho, Yamazumi, Siraiwazawa (1100 m); Misakubo-cho, Misakubo Dam (550 m); HK: Negata, Gansui-ji (100 m); TR: Tsuki (90 m); Aoya (160 m); SY: Haruno-cho, Moriyama (300 m); Haruno-cho, Ishikiri (300 m); HB: Kawane-cho, Shiomoto (180 m); Sagara-cho. Megami-yama (80 m); SI: Chiba-san (350 m); SD: Okabe-cho, Megurizawa (150 m); SK: Okusenmata (670 m); Kuchisa-kamoto (550 m); Sugio (620 m); Utsunoya (100 m); Sekibe (10 m); Inuma, Hirata (600 m); SZ: Taru-tôge (400 m); FG: Shibakawa-cho, Kaminako, Iriyama (350 m); ST: Oyama-cho, Mikuni-yama (1100 m); SN: Jûrigi (900 m); TG: Kannami-cho, south of Yugawara-tôge (800 m); KM: Matsuzaki-cho, Yakiyama (60 m); Minamiizu-cho, Iruma

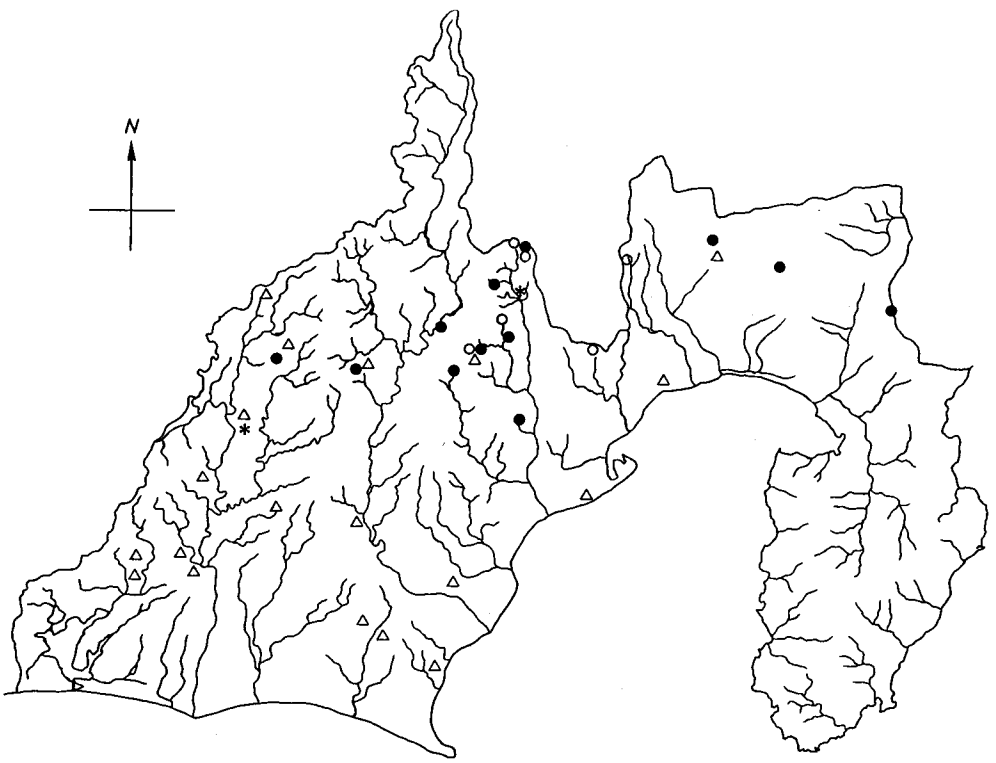

Fig. 8. Distributions of 4 clausiliid species: ●, *Mundiphaedusa dorcas*; ○, *M. rex*; △, *M. rhopalia*; ✱, *M. sericina*.

(10 m)

Vastina hickonis hickonis (BOETTGER, 1877) Fig. 9
IG: Misakubo-cho, Aokuzure-tôge (1080 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m)

Vastina hickonis mikawa (PILSBRY, 1905) Fig. 9
KS: Utsuyama (10 m); IN: Inasa-cho, Tokka (200 m); Hosoe-cho, Ime (10 m); HN: Arai-cho, Uchiyama (20); HM: Washizawa-cho (120 m); Kanzanji (30 m); Wakô-cho (40 m); TR: Kitakashima (200 m); IG: Sakuma-cho, Kamihirayama, Nagoo (120 m)

Vastina ikenoi (MINATO, 1980)
TR: Komatsuzaki (200 m ; Minato, 1980)

Stereophaedusa japonica japonica (CROSSE, 1871) Fig. 10
IG: Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m); SY: Haruno-cho, Moriyama (300 m); KK: Takinoya (100 m); HB: Omaezaki-cho, Omaezaki (20 m); Sagara-cho,

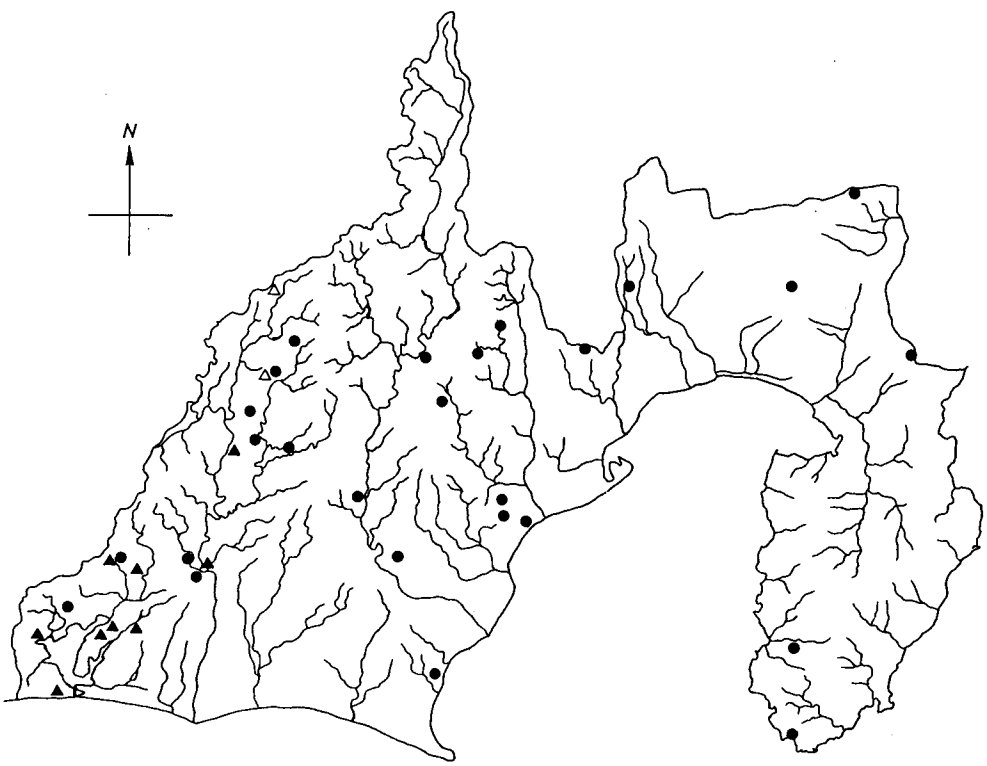

Fig. 9. Distributions of 3 clausiliid species: ●, *Megalophaedusa martensii*; △, *Vastina hickonis hickonis*; ▲, *V. h. mikawa*

megami-yama (80 m)

Stereophaedusa japonica oostoma (MOELLENDORFF, 1882) Fig. 10
SK: Ikawa, Ikawa-tôge (1600 m); Umegashima, Abe-tôge (1450 m); Sunpujô (60 m); Sekibe (10 m); Oshika (10 m); Ooya (20 m); FM: Fuji-san, Shiratsuka-rindo (1330 m); GT: Ninooka, Ninooka-jinja (500 m); TG: Kannami-cho, south of Yugawara-tôge (800 m)

Stereophaedusa gouldi (ADAMS, 1868) Fig. 10
SK: Ooya (20 m); Furuyado (30 m); Negoya, Takizawa (30 m); SZ: Komagoe, Komagoe-jinja (10 m); IH: Yui-cho, Satta-tôge (200 m); Kagiana (200 m); NZ: Oooka, Kisegawa (10 m); Hara, Ootsuka (10 m); TG: Toi-cho, Odoi (40 m); Kannami-cho, Hirai (50 m); Heda, Funayama (10 m); Heda-mura, Heda Mihamazaki (5 m); Toi-cho, Koshimoda (40 m); Amagiyugashima-cho, Amagi-san (800 m); KM: Kamo-mura, Ugusu, Kogane-zaki (10 m); Nishiizu-mahci, Ootago (20 m); Matsuzaki-cho, Yakiyama (60 m); Minamiizu-cho, Koura (10 m); Minamiizu-cho, Iruma (10 m); Mianamiizu-cho, Shimokamo (10 m); Minamiizu-cho, Irô-zaki (20 m); Kawazu-cho, Tanaka, Kinomiyajinja (10 m); Kawazu-

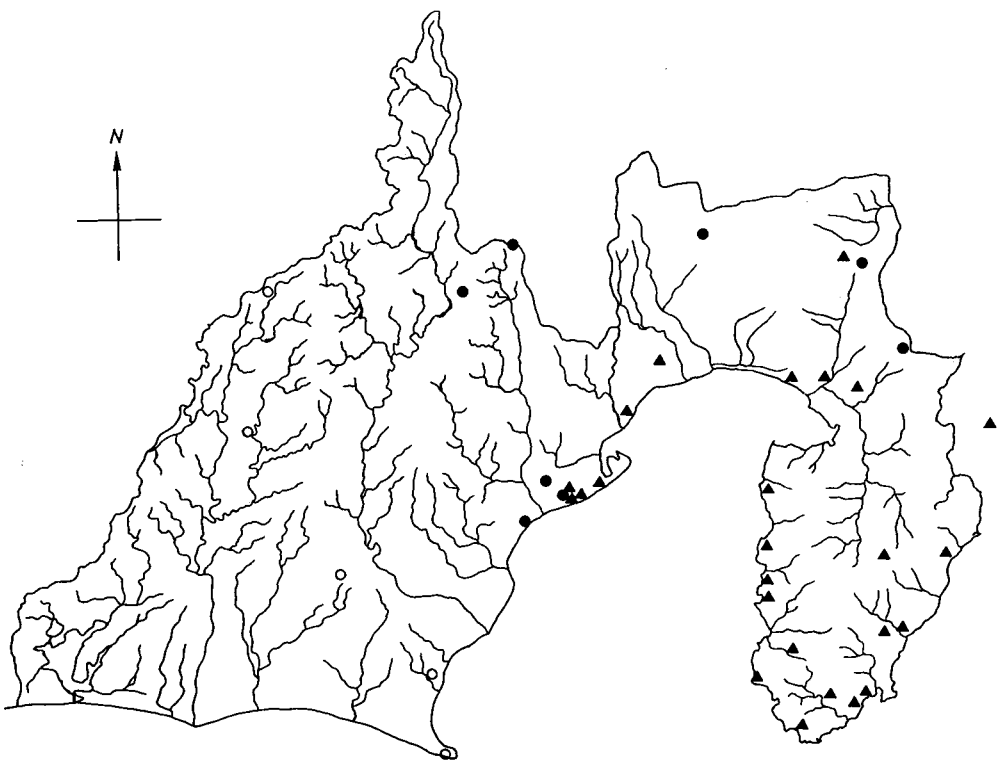

Fig. 10. Distributions of 3 clausiliid species: ○, *Stereophaedusa japonica japonica*; ●, *S. j. oostoma*; ▲, *S. gouldi*.

cho, Mine (100 m); SM: Tôji (5 m); Kisami (10 m); AT: Hatsushima (20 m); IT: Akazawa (450 m)

Euphaedusa Tau (BOETTGER, 1877) Fig. 4
KS: Shirasuka, Shiomizaka (10 m); TR: Yamahigashi, Sakae (50 m); SY: Mori-machi, Nishimata (100 m); SK: Shizuhata-yama (110 m); Mochimune (50 m); Oshika (90 m); Ooya (50 m)

Phaedusa sieboldii (KÜSTER, 1847) Fig. 4
AT: Hatsu-shima (20 m)

Reinia variegata (A. ADAMS, 1868) Fig. 4
TG: Heda-mura, Mihama-zaki (5 m)

Pictophaedusa euholostoma (PILSBRY, 1901) Fig. 4
GT: Mikuriya (500 m) (Pilsbry, 1901)

Suborder Sigmurethra
Superfamily Achatinacea

Family Subulinidae

Allopeas javanicum (REEVE, 1849)
HM: Sôzu-cho (10 m); IG: Asaba-cho, Hachiman (10 m); HB: Sagara-cho, Megami-yama (80 m); Omaezaki-cho, Omaezaki (20 m); Omaezaki-cho, Shiraha (30 m); SD: Ooigawa-cho, Aikawa (20 m); Ooigawa-cho, Shimokosugi (5 m); SK: Furuyado (30 m); FJ: Suzukawa (10 m); NZ: Hara (10 m); Oooka, Kise-gawa (10 m); Oooka, Kise-gawa (10 m); Oooka, Kise-gawa (10 m); TG: Kannami-cho, HIrai (50 m); Heda-mura, Heda, Mihama-zaki (5 m); Toi-cho, Odoi (20 m); KM: Nishiizu-machi, Ootago (20 m); Kawazu-cho, Hama (10 m)

Allopeas clavulinum kyotoense (PILSBRY & HIRASE, 1904)
KS: Bôse (60 m); Shirasuka, Shiomizaka (10 m); IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Okuyama Kuma (180 m); Inasa-cho, Mitake (280 m); Inasa-cho, Higashishimura (100 m); Hosoe-cho, Ime (10 m); HM: Enshû-cho, Ime (10 m); HM: Enshû-hama (5 m); Takizawa (200 m); Kanzanji (20 m); Washizawa-cho (120 m); HK: Negata, Gansui-ji (60 m); TR: Aoya (160 m); Yamahigashi Sakae (50 m); IG: Sakuma-cho, Sakuma Dam (260 m); Misakubo-cho, Misakubo Dam (550 m); Shirakura-gawa, (950 m); IW: Iwai, Tsurugaike (10 m); KK: Oono, Nakagumi (80 m); Awaga-take (480 m): OG: Oosuka-cho, Oobuchi (10 m); Daitô-cho, Iriyamase (100 m); Kikugawa-cho, Hansei (60 m); Kikugawa-cho, Hotta (40 m); Kikugawa-cho, Rokugo (40 m); Hamaoka-cho, Sakura (20 m); HR: Haibara-cho, Kashima (5 m); Yoshida-cho, Takashima (10 m); Sagara-cho, Megami-

yama (80 m); Omaezaki-cho, Omaezaki (20 m); Omaezaki-cho, Shiraha (30 m); FE: Sangenya (30 m); SD: Ooigawa-cho, Shimokosugi (5 m); SK: Ooya (50 m); Kunô (10 m); Sekibe (10 m); Ooya-kuzure (1200 m; FJ: Ashitaka-yama, Sudo-gawa (750 m); Imaizumi (40 m); Suzukawa (20 m); ST: Nagaizumi-cho, Honjuku (25 m); SN: Jûrigi (900 m); Fukara-shinden (200 m); NZ: Oooka, Kise-gawa (10 m); Hara (10 m); Uchiura (10 m); Wakamatsu-zaki (20 m); TG: Kannami-cho, south of Yugawara-tôge (800 m); Kannami-cho, Hirai (50 m); Heda-mura, Heda, Mihama-zaki (5 m): Toi-cho, Odoi (20 m); KM: Kamo-mura, Ugusu (10 m); Kamo-mura, Arari (40 m); Minamiizu-cho, Shimogamo (10 m); Kawazu-cho, Hama (10 m); Kawazu-cho, Tanaka (10 m); SM: Tôji (5 m); AT: Midorigaoka-cho (220 m); Hatsu-shima (20 m)

Superfamily Streptaxacea

Family Streptaxidae

Sinoennea iwakawa (PILSBRY, 1900)

IN: Mikkabi-cho, Okuhirayama (180 m); Inasa-cho, Mitake (280 m); Inasa-cho, Nishishimura, Nakamura (70 m); Inasa-cho, Higashishimura (90 m); IG: Sakuma-cho Kamihirayama, Nagoo (120 m); Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Arimoto (500 m); TR: Aoya (160 m); HK: Negata, Gansui-ji (60 m); HM: Takizawa (200 m); SY: Haruno-cho, Moriyama (300 m); Haruno-cho, Ishikiri (300 m); KK: Oono, Nakagumi (80 m); Awagatake (480 m); HB: Kawane-cho, Shiomoto (180 m); Kawane-cho, Oowada (160 m); Kanaya-cho, Fukuyo, Hakko-gawa (150 m); Sagara-cho, Megamiyama (80 m); SI: Uami (250 m); FE: Yahata (50 m); SD: Okabe-cho, Megurizawa (150 m); SK: Ikawa, Kanzô (650 m); Kuchisakamoto (550 m); Do, Shirasawa (320 m); Utsunoya (100 m); Umegashima, Sekinosawa (460 m); Ookuzure (10 m); Kunô (10 m); IH: Fujikawa-cho, Kitamatsuno, Horinouchi (80 m); FG: Shibakawa-cho, Kamiinako Iriyama (350 m); FM: Inogashira (690 m); GT: Ninooka, Ninooka-jinja (500 m); TG: Amagiyugashima-cho, Kayano; KM: Kamo-mura, Nishina-tôge (600 m); SM: Tôji (5 m); AT: Midorigaoka-cho (220 m)

Superfamily Arionacea

Family Punctidae

Punctum japonicum PILSBRY, 1900

IN: Hosoe-cho, Ime (10 m); HM: Sanshincho (5 m); IG: Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); SI: Kamiza (90 m); SK: Ooya (50 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); IH: Fujikawa-cho, Saginota (300 m); KM: Matsuzaki-cho, Benten-jima (10 m); SM: Shirahama (10 m)

Punctum rota PILSBRY & HIRASE, 1904

IN: Inasa-cho, Mitake (280 m); Inasa-cho, Okuyama, Kuma (180 m); Inasa-cho Nishikurumegi (170 m); TR: Aoya (160 m); HM: Takizawa (200 m); IG: Sakuma-cho, Saku-

ma Dam (260 m); Sakuma-cho, Ryûtô-san (1250 m); Misakubo-cho, Aokuzure-tôge (1080 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); Misakubo-cho, Shirakura-zawa, (950 m); Misakubo-cho, Tochû-gawa, (1010 m); Misakubo-cho, Kurohôshidake Tôkô-one (1530 m); Misakubo-cho, Kadoketa (550 m); SK; Kanzô (650 m); Ooya (50 m); SZ: Taru-tôge (400 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); FM: Nebara (1000 m); Fumoto (1050 m); Inogashira (690 m); FJ: Ashitaka-yama, Sudogawa (750 m); ST: Oyama-cho, Mikuni-yama (1100 m); Oyama-cho, Shimoisshiki (420 m); Oyama-cho, Fuji-san, Subashiri-tozandô (1350 m, 1500 m, 1700 m, 2000 m); Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa (520 m); SN: Chabatake (300 m); NZ: Wakamatsu-zaki (20 m); KM: Minamiizu-cho, Iruma (10 m); SM: Tôji (5 m); AT: Midorigaoka-cho (220 m); IT: Akazawa (450 m)

Family Discidae

Discus pauper (GOULD, 1859)

HB: Honkawane-cho, Sobatsubu-yama (1350 m); SK: Umegashima, Ooya-kuzure (1250 m); Ikawa, Ikawa-tôge (1600 m); ST: Oyama-cho, Fuji-san, Subashiri-tozandô (2000 m); NZ: Oooka, Kisegawa (10 m)

Family Arionidae

Nipponolimax monticola YAMAGUCHI & HABE, 1955

IG: Misakubo-cho, Nakanoone-yama (1980 m)

Family Philomycidae

Meghimatium bilineatum (BENSON, 1842)

OG: Kikugawa-cho, Shimohansei (40 m); Hamaoka-cho, Shiobarashinden (20 m)

Meghimatium fruhstorferi (COLLINGE, 1901)

HM: Kanzanji (20 m) IG: Sakuma-cho, Ryûtô-san (1250 m); SI: Minari, Kawaguchi (180 m); SK: Ikawa, Sasa-yama (1650 m); Umegashima, Ooya-kuzure (1250 m); Shizuhata-yama (50 m) ST: Oyama-cho, Fuji-san, Subashiri-tozandô (1350 m); GT: Fuji-san, Tarôbô (1300 m); SN: Chabatake (200 m); NZ: Oooka, Kise-gawa (10 m)

Superfamily Succineacea

Family Succineidae

Oxyloma hirasei (PILSBRY, 1901)

FR: Kamiishino (30 m); OG: Kikugawa-cho, Hansei (60 m); SK: Yawata (30 m)

Superfamily Limacacea

Family Helicarionidae

Trochochlamys crenulata (GUDE, 1900)

KS: Utsu-yama (10 m); Shirasuka, Shiomizaka (10 m); Bôse (60 m); IN: Inasa-cho, Tokka (200 m); Inasa-cho, Okuyama, Kuma (180 m); Inasa-cho, Tabata, Ryûgashi-dô, (80 m); Inasa-cho, Higashishimura (120 m); Inasa-cho, Nishikurumegi (170 m); Inasa-cho, Higashikurumegi (120 m); Hosoe-cho, Ime (10 m); HM: Takizawa (200 m); IG: Misakubo-cho, Aokuzure-tôge (1000 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); Misakubo-cho, Shirakura-gawa, (950 m); Misakubo-cho, Misakubo Dam (530 m); Misakubo-cho, Kadoketa (550 m); SY: Haruno-cho, Ishikiri (300 m); KK: Oono, Nakagumi (80 m); Awaga-take (480 m); Haramiishi (100 m); OG: Daito-cho, Iriyamase (100 m); Kikugawa-cho, Hansei (60 m); Kikugawa-cho, Rokugô (40 m); Kikugawa-cho, Sabaka (140 m); Kikugawa-cho, Hotta (40 m); HB: Nakakawane-cho, Sobatsubu-yama (1340 m); Kawane-cho, Shiomoto (180 m); SK: Umegashima, Sakasa-gawa (1120 m); Ooma, Fukuyôzawa (750 m); Do, Shirasawa (320 m); Ashikubo, Kurishima (170 m); Oshika (20 m); Ooya (50 m); Hirano, Mafuji-san (900 m); Ookuzure (10 m); SZ: Itaizawa (200 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); FM: Inogashira (690 m); ST: Oyama-cho, Mikuni-yama (1100 m); Oyama-cho, Shimoisshiki (420 m); Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa (520 m); GT: Ninooka, Ninooka-jinja (500 m); SN: Chabatake (300 m); TG: Shuzenji-cho, Shuzenji (200 m); SM: Kisami (10 m); AT: Midorigaoka-cho (220 m);

Trochochlamys praealta (PILSBRY, 1902)
SI: Chiba (200 m); SK: Shizuhata-yama (140 m); GT: Ninooka-jinja (500 m)

Trochochlamys lioconus goniozona (PILSBRY & HIRASE, 1905)
SN: Chabatake (300 m); KM: Matsuzaki-cho, Jaishi-tôge (300 m); IT: Tôtari (100 m); Akazawa (450 m)

Trochochlamys subcrenulata (PILSBRY, 1901)
IN: Inasa-cho, Mitake (280 m); Inasa-cho, Shihôjô (160 m); Inasa-cho, Higashikurumegi (130 m); IG: Misakubo-cho; Yamazumi, Shiraiwa-zawa (1100 m); Kadoketa (550 m); HM: Takizawa (200 m); OG: Daitô-cho, Iriyamase (100 m); HB: Sagara-cho, Megamiyama (80 m); SI: Minari, Kawaguchi (180 m); Ikumi, Futamata (280 m); FE: Fudôkyoþ (120 m); SK: Kuchisakamoto (550 m), Ashikubo, Kurishima (150 m); Ooya (50 m); FG: Shibakawa-cho, Kamiinako, Iriyama (350 m); AT: Midorigaoka-cho (220 m); IT: Ukiyama (50 m)

Trochochlamys fraterna (PILSBRY, 1900)
IN: Inasa-cho, Mitake (280 m); Inasa-cho, Nishishimura, Nakamura (70 m); IG: Sakuma-cho, Urakawa, Kôchiguchi (480 m); Misakubo-cho, Aokuzure-tôge (1000 m); Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Nuno-taki (60 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); Misakubo-cho, Keta-gawa, Toyooka, Dam (450 m); Tatsuyama-mura, Ichinose (320 m); HK: Negata,

Gansui-ji (60 m); SY: Haruno-cho, Toyooka, Myôjinkyô (400 m); Mori-machi, Funanba (200 m); KK: Oono Nakagumi (80 m); OG: Kikugawa-cho, Hansei (60 m); HB: Honkawane-cho, Fujikawa (400 m); SI: Ikumi, Futamata (280 m); FE: Yahata (50 m); SD: Okabe-cho, Megurizawa (150 m); SK: Ikawa, Inuma (600 m); Umeji (650 m); Hirano, Mafuji-san (900 m); Umegashima, Sakasa-gawa (1240 m); Umegashima, Sekinosawa (460 m); IH: Fujikawa-cho, Kitamatsuno, Horinouchi (80 m); FM: Nebara (1000 m); ST: Oyama-cho, Mikuni-yama (1100 m); SN: Chabatake (300 m); TG: Kannami-cho, Hakone-tôge, upper stream of Raikô-gawa (700 m); Shuzenji-cho, Shuzenji (200 m); AT: Midorigaoka-cho (220 m)

Parakaliella harimensis (PILSBRY, 1901)
IN: Hosoe-cho, Ime (10 m); HK: Negata, Gansui-ji (100 m); IG: Sakuma-cho, Ryuto-san (1250 m); Misakubo-cho, Kadoketa (550 m); Sakuma-cho, Kamihirayama, Nagoo (120 m); HM: Takizawa (20 m); OG: Kikugawa-cho, Hotta (40 m); Oosuka-cho, Oobuchi (10 m); HB: Omaezaki-cho, Omaezaki (10 m, 40 m); SK: Hatanagi, Aonagi-yama (2040 m); Umegashima, Ooya-kuzure (1200 m); FJ: Ukishima-numa (5 m); FM: Fumoto (1050 m); Inogashira (690 m); ST: Oyama-cho, Fuji-san, Subashiri-tozandô (1350 m); TG: Hedamura, Heda, Mihamazaki (5 m); KM: Matsuzaki-cho; Benten-jima (10 m)

Parakaliella pagoduloides (GUDE, 1900)
IN: Inasa-cho, Mitake (280 m); IG: Misakubo-cho, Shirakura-gawa (950 m); HR: Sagara-cho, Megami-yama (80 m); Sagara-cho, Ogami-yama (40 m)

Parakaliella ruida (PILSBRY, 1901)
HR: Nakakawane-cho, Sobatsubu-yama (1350 m)

Gastrodontella stenogyra (A. ADAMS, 1868)
KS: Utsu-yama (10 m): Bôse (60 m); IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Mitake (280 m); Inasa-cho, Okuyama, Kuma (180 m); Inasa-cho, Tabata, Ryûgashidô (80 m); Inasa-cho, Nishishimura, Nakamura (70 m); Inasa-cho, Higashishimura (90 m); Hosoe-cho, Ime (10 m); HM: Washizawa-cho (120 m); Takizawa (200 m); TR: Aoya (160 m); HK: Negata, Gansui-ji (100 m); IG: Sakuma-cho, Sakuma Dam (260 m); Sakuma-cho, Kamihirayama, Nagoo (120 m); Misakubo-cho, Aokuzure-tôge (1000 m); Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Arimoto (500 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); Misakubo-cho, Kadoketa (550 m); Misakubo-cho, Keta-gawa, Toyooka-dam (450 m); Misakubo-cho, Shirakura-gawa (1950 m); SY: Haruno-cho, Ishikiri (300 m); Haruno-cho, Hirano (150 m); Mori-machi, Nishimata (100 m); HB: Sagara-cho, Megami-yama (80 m); SI: Uami (250 m); SK: Kuchisakamoto (550 m); Do, Shirasawa (320 m); Ooya (50 m); Umegashima, Ooya-kuzure (1200 m); SZ: Yoshiwara (240 m); FM: Nebara (1000 m); Fumoto (1050 m); Inogashira (690 m); Fuji-san, Tenshôkyôsha (1000 m); FJ: Imaizumi (40 m); SN: Jûrigi (900 m); NZ: Oooka, Kisegawa

(10 m); TG: Kannami-cho, south of Yugawara-tôge (800 m); AT: Midorigaoka-cho (220 m)

Discoconulus sinapidium (REINHARDT, 1877)
KS: Shirasuka, Shimizaka (10 m); IN: Hsoe-cho, Ime (10 m); Inasa-cho, Higashishimura (90 m); Nishikurumegi (170 m); Higashikurumegi (120 m); Higashikurumegi-shinden (100 m); HM: Takizawa (200 m); IG: Misakubo-cho, Shirakura-gawa (950 m); Yamazumi, Shiraiwa-zawa (1050 m); Misakubo Dam (550 m); Keta-gawa, Toyooka Dam (450 m); Aokuzure-tôge (1000 m); Tochû-gawa, Hikage-zawa (1000 m); Kurohôshi- dake, Tôkô-one (1530 m); Kadoketa (550 m); Sakuma-cho, Sakuma Dam (260 m); Urakawa, Kawachiguchi (480 m); Kamihirayama, Nagoo (120 m); SY: Mori-machi, Nishimata (100 m); Funanba (200 m); Haruno-cho, Toyooka, Myôjinkyô (400 m); KK: Oono, Nakagumi (80 m); Awaga-take (480 m); OG: Kikugawa-cho, Rokugô (40 m); HB: Honkawane-cho, Umeji, Kanzô (550 m); Nakakawane-cho, Rokugô (40 m); Haibara-gawa (600 m); SD: Okabe-cho, Takakusa-yama, Megurizawa (150 m); SK: Umegahsima, Sekinosawa (460 m); Sakasa-gawa (1120 m); Hatanagi, Aonagi-yama (2040 m); Ooya (50 m); SZ: Itaizawa (200 m); Oodaira, Sora-sawa (500 m); IH: Fujikawa-cho, Saginota (300 m); FG: Shibakawa-cho, Kamiinako, Iriyama (350 m); FM: Nebara (1000 m); Fumoto (1050 m); Inogashira (690 m); Myôjô-san (180 m); ST: Oyama-cho, Fuji-san, Subashiri-tozandô (1500 m); TG: Kannami-cho, Hakone-tôge (700 m); KM: Matsuzaki-cho, Bentenjima (10 m); AT: Hatsu-shima (20 m)

Sitalina circumcincta (REINHARDT. 1883)
KS: Utsu-yama (10 m); IN: Inasa-cho, Okuyama, Kuma (180 m); Nishikurumegi (170 m); IG: Misakubo-cho, Misakubo Dam (550 m); HM: Takizawa (200 m); SY: Mori-machi, Funanba (200 m); KK: Awaga-take (480 m); Oono, Nakagumi (80 m); OG: Daito-cho, Iriyamase (100 m); Kikugawa-cho, Hansei (60 m); Kikugawa-cho, Rokugo (40 m); HB: Kawane-cho, Shiomoto (180 m); Kanaya-cho, Fukuyo, Hakko-gawa (100 m); Sagara-cho, Ogami-yama (40 m); SI: Minari, Kawaguchi (180 m); FE: Yahata (50 m); SK: Ikawa, Inuma (600 m); Umegashima, Sekinosawa (460 m); Okusenmata (670 m); Hirano, Mafuji-yama (900 m); Ooya (50 m); IH: Fujikawa-cho, Kitamatsuno, Horinouchi (80 m); Fujikawa-cho, Saginota (300 m); FM: Inogashira (690 m); AT: Midorigaoka-cho (220 m)

Sitalina japonica HABE, 1964
KS: Shirasuka, Shiomizaka (10 m); IN: Inasa-cho, Mitake (280 m); Inasa-cho, Tokka (200 m); IG: Misakubo-cho, Misakubo Dam (550 m); KK: Takinoya (100 m); HB: Sagara-cho, Megami-yama (80 m); Sagara-cho, Ogami-yama (40 m); TG: Heda-mura, Heda, Mihama-zaki (50); AT: Midorigaoka-cho (220 m)

Parasitala nanodes (GUDE, 1900)
IN: Inasa-cho, Mitake (280 m); IG: Misakubo-cho, Shirakura-gawa (950 m); SK: Yunoshima (280 m); Kuchisakamoto (550 m); Oshika (20 m); Ooya (50 m); SZ: Okitsu, Taru-tôge (400 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); FM: Yamamiya (650 m); FJ: Suzukawa (20 m); ST: Oyama-cho, Nakajima (400 m); SN: Chabatake (300 m); TG: Kannami-cho, south of Yugawara-tôge (800 m); KM: Kawazu-cho, Tanaka (10 m)

Parasitala reinhardti (PILSBRY, 1900)
IN: Inasa-cho, Tokka (200 m); Inasa-cho, Higashikurumegi (130 m); HK: Negata, Ganssui-ji (100 m); HM: Takizawa (200 m); IG: Sakuma-cho, Sakuma Dam (260 m); Sakuma-cho, Ryûtô-san (1250 m); Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Misakubo Dam (550 m); Tatsuyama-mura, Ichinose (320 m); OG: Kikugawa-cho, Hansei (60 m); HB: Kawane-cho, Shiomoto (180 m); SK: Ikawa, Kanzô (550 m); Hirano, Mafuji-san (900 m); Shizuhata-yama (110 m); Oshika (20 m); Ooya (50 m); Furuyado (20 m); SZ: Tashiro-tôge (750 m); FM: Yamamiya (650 m); FJ: Imaizumi (40 m); Suzukawa (10 m); NZ: Uchiura (10 m); TG: Toi-cho, Odoi (20 m); IT: Tôtari (100 m)

Yamatochlamys vaga (PILSBRY & HIRASE, 1904)
IN: Inasa-cho, Mitake (280 m); HM: Kanzanji (20 m); FR: Ogasa-yama, Kamiishino (100 m); KK: Awaga-take (480 m); OG: Kikugawa-cho, Hotta (40 m); HR: Kanaya-cho, Fukuyo, Hakko-gawa (100 m); SK: Kuchisakamoto (550 m); Nagakuma, Nunomaki-zawa (250 m); Ashikubo, Shikichi (150 m); Ashikubo, Kurishima (150 m); Umegashima, Magosajima, Ippuku-tôge (1100 m); Ooya (50 m); SZ: Yoshiwara (240 m); TG: Toi-cho, Koshimoda (40 m); KM: Kawazu-cho, West of Noborio (550 m); IT: Ukiyama (50 m)

Yamatochlamys lampra (PILSBRY & HIRASE, 1904)
TR: Aoya (160 m); IG: Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Kadoketa (550 m); OG: Oosuka-cho, Oobuchi (10 m); Kikugawa-cho, Hansei (60 m); HB: Nakakawane-cho, Sobatsubu-yama (1340 m); Sagara-cho, Megami-yama (80 m); Sagara-cho, Ogami-yama (40 m); Omaezaki-cho, Omaezaki (20 m); SD: Okabe-cho, Takakusa-yama (150 m); NZ: Kanuki-yama (100 m); Uchiura (10 m); Wakamatsu-zaki (20 m); AT: Midorigaoka-cho (220 m)

Ceratochlamys ceratodes (GUDE, 1900)
IG: Sakuma-cho, Sakuma Dam (260 m); Sakuma-cho, Ryûtô-san (1250 m); HB: Nakakawane-cho, Sobatsubu-yama (1340 m); SK: Ikawa, Ikawa-tôge (1600 m); Ikawa, Kanzo (650 m); Umegashima, Sakasa-gawa (1120 m); Utsunoya (100 m); SZ: Tashiro-tôge (750 m); FM: Chôjaga-take (860 m); KM: Kamo-mura, Nishina-tôge (600 m); Kawazu-cho, Sakashita (220 m)

Bekkochlamys septentrionalis (JACOBI, 1898)
IG: Misakubo-cho, Aokuzure-tôge (1000 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); TR: Funagira (50 m); SY: Haruno-cho, Moriyama (300 m); HB: Nakakawane-cho, Sobatsubu-yama (1340 m); FM: Fumoto (1150 m); TG: Amagiyugashima-cho, Toi-tôge (580 m)

Urazirochlamys doenitzii (REINHARDT, 1877)
KS: Utsu-yama (10 m); IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Okuyama, Kuma (180 m); Inasa-cho, Higashishimura (100 m); HM: Washizawa-cho (120 m); Takizawa (200 m); TR: Aoya (160 m); HK: Negata, Gansui-ji (100 m); IG: Sakuma-cho, Sakuma Dam (260 m); Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m); IW: Teratani (100 m); SY: Haruno-cho, Hirano (150 m); KK: Awaga-take (480 m); Takinoya (100 m); OG: Oosuka-cho, Oobuchi (10 m); Kikugawa-cho, Hansei (60 m); Okuyokoji (50 m); Hamaoka-cho, Shiobarashinden (20 m); HB: Kawane-cho, Shiomoto (180 m); Sagara-cho, Megami-yama (80 m); Sagara-cho, Ogami-yama (40 m); Omaezaki-cho, Omaezaki (20 m); SI; Uami (250 m); FE: Yahata (50 m); YZ: Obama (10 m); SK: Umegashima, Sakasa-gawa (1120 m); Ashikubo, Kurishima (150 m); Shzuhata-yama (110 m); Sekibe (10 m); Mochimune (40 m); Oshika (20 m); Ooya (50 m); FG: Shibakawa-cho, Kamiinako, Iriyama (350 m); FM: Myôjô-san (180 m); Fuji-san, Tenshôkyôsha (1000 m); GT: Ninooka, Ninooka-jinja (500 m); SN: Fukarashinden (200 m); NZ: Oooka, Kise-gawa (10 m); Uchiura (10 m); Wakamatsuzaki (20 m); TG: Kannami-cho, Karuizawa (350 m); Shuzenji-cho, Shuzenji (200 m); Toi-cho, Odoi (20 m); Nakaizu-cho, Shimoshiraiwa (100 m); KM: Kamo-mura, Arari (10 m); Kawazu-cho, Sakashita (220 m); SM: Tsumeki-zaki (5 m); AT: Izusan (200 m); Midorigaoka-cho (220 m); Hatsu-shima (20 m); IT: Ukiyama (50 m)

Nipponochlamys semisericata (PILSBRY, 1902)
IN: Inasa-cho, Higashikurumegishinden (100 m); Inasa-cho, Higashikurumegi (120 m); IG: Misakubo-cho, Aokuzure-tôge (1080 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m); Keta-gawa, Toyooka Dam (450 m); SY: Haruno-cho, Moriyama (300 m); HB: Nakakawane-cho, Sobatsubu-yama (1350 m); SI: Minari, Kawaguchi (180 m); SK: Umegashima, Magosajima, Ippuku-tôge (1100 m); Umegashima, Ooyakuzure (1200 m); Umegashima, Sakasa-gawa (1120 m); Abe-tôge (1450 m); Okusenmata (670 m); Kuchisakamoto (550 m); Ooma, Fukuyô-zawa (750 m); Do, Shirasawa (320 m); Ashikubo, Kurishima (150 m); Kitanumagami, Hirayama (130 m); Ooya (50 m); FM: Nebara (1000 m); Fumoto (1050 m); Fuji-san, Tenshôkyôsha (1000 m); ST: Oyama-cho, Mikuni-yama (1100 m); Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa (520 m); SN: Jûrigi (900 m); NZ: Oooka, Kisegawa (10 m); TG: Shuzenji-cho, Shuzenji (200 m); Toi-cho, Koshimoda (40 m); KM: Minamiizu-cho, Irô-zaki (20 m)

Otesiopsis Japonica (MOELLENDORFF, 1885)
ST: Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa (520 m); GT: Ninooka, Ninooka-jinja (500 m)

Japanochlamys cerasina (PILSBRY, 1902)
IG: Misakubo-cho, Aokuzure-tôge (1000 m, 1080 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); HB: Honkawane-cho, Sobatsubu-yama, (1340 m); SD: Okabe-cho, Takakusa-yama (150 m); YZ: Obama (10 m); SK: Ikawa, Sasa-yama (1650 m); Umegashima, Ooya-kuzure (1250 m); Abe-tôge (1450 m); Ookuzure (40 m); FM: Fuji-san, Shiratsuka-rindô (1320 m); SN: Jûrigi (900 m); TG: Kannami-cho, Hakone-tôge, Upper stream of Raikô-gawa (700 m); KM: Minamiizu-cho, Koura (10 m)

Japanochlamys hakonensis (PILSBRY & HIRASE, 1905)
SK: Umegashima, Ooya-kuzure (1200 m); Do, Shirasawa (320 m); FM: Fuji-san, Tenshôkyôsha (1000 m); SN: Jûrigi (950 m); ST: Oyama-cho, Fuji-san, Subashiri-tozandô (1350 m); GT: Fuji-san, Tarôbô (1300 m); TG: Shuzenji-cho, Daruma-yama (900 m)

Family Zonitidae

Hawaiia minuscula (BINNEY, 1840)
OG: Kikugawa-cho, Hansei (60 m); Hamaoka-cho, Sakuragaike (20 m); SK: Furuyado (20 m); FJ: Suzukawa (20 m); ST: Nagaizumi-cho, Honjuku (25 m); TG: Heda-mura, Heda, Mihama-zaki (5 m)

Zonitoides nitidus (MÜLLER, 1774)
ST: Oyama-cho, Fuji-san, Subashiri-tozandô (1350 m); GT: Fuji-san, Tarôbô (1300 m)

Zonitoides arboreus (SAY, 1816)
KS: Shirasuka, Shiomizaka (10 m); OG: Kikugawa-cho, Hansei (60 m); Kikugawa-cho, Hotta (40 m); Hamaoka-cho, Sakura (20 m); HB: Haibara-cho, Kahsima (5 m); Omaezaki-cho, Omaezaki (40 m); Omaezaki-cho, Shiraha (30 m); SD: Ooigawa-cho, Aikawa (20 m); Ooigawa-cho, Shimokosugi (5 m); SK: Ooma, Fukuyô-zawa (750 m); Takamatsu (20 m); Furuyado (30 m); FJ: Suzukawa (20 m); ST: Nagaizumi-cho, Honjiku (25 m); GT: Ninooka, Ninooka-jinja (500 m); SN: Fukarahsinden (200 m); NZ: Oooka, Kisegawa (10 m); TG: Kannami-cho, Hirai (50 m); Heda-mura, Heda, Mihamazaki (5 m); KM: Matsuzaki-cho, Bentenjima (10 m); Minamiizu-cho, Shimokamo (10 m); SM: Tôji (5 m); AT: Hatsu-sima (20 m)

Family Limacidae

Limax flavus LINNÉ, 1758
FJ: Suzukawa (20 m)

Limax marginatus MÜLLER, 1774
HM: Enshûhama (5 m); Murakushi (5 m); TR: Yamahigashi, Sakae (50 m); IG: Asaba-cho, Hachiman (10 m); OG: Oosuka-cho, Oobuchi (10 m); Hamaoka-cho, Sakura (20 m); HB: Omaezaki-cho, shiraha (30 m); SD: Ooigawa-cho, Aikawa (20 m); SK: Sengen-jinja (40 m); FJ: suzukawa (20 m); Ukishima-numa (5 m); NZ: Oooka, Kise-gawa (10 m); Uchiura (10 m); TG: Kannami-cho, Hirai (50 m); Heda-mura, Heda, Mihamazaki (5 m); KM: Kawazu-cho, Tanaka (10 m)

Deroceras varians (A. ADAMS, 1868)
OG: Daitô-cho, Chihama (10 m)

Superfamily Camaenacea

Family Camaenidae

Satsuma myomphala (MARTENS, 1865)
FM: Myôjô-san (180 m)

Satsuma moellendorffiana moellendorffiana (PILSBRY & HIRASE, 1903)
TG: Amagiyugashima-cho, Kayano (480 m); KM: Kamo-mura, Arari (20 m); Kamo-mura Nishina-tôge (600 m)

Satsuma moellendorffiana thaanumi (PILSBRY, 1924)
HB: Honkawane-cho, Nagashima (600 m); Nakakawane-cho, Sobatsubu-yama (1350 m); SK: Kuchisakamoto (550 m); Okusenmata (670 m); Do, Shirasawa (320 m); Kuchisenmata (480 m); Nyûjima (380 m); SZ: Oodaira (500 m); Taru-tôge (400 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); Shibakawa-cho, Kamiinako, Miyaji (160 m); Shibakawa-cho, Kamiinako, Iriyama (350 m); FM: Chôjage-take (860 m); FJ: Ashitaka-yama, Sudo-gawa (600 m); SN: Jûrigi (870 m); ST: Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa

Satsuma japonica japonica (PFEIFFER, 1847)
KS: Utsu-yama (10 m); Bôse (60 m); Shirasuka, Shiomizaka (10 m); IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Tokka (200 m); Inasa-cho, Mitake (280 m);Inasa-cho, Tabata (80 m); Inasa-cho, Higashishimura (100 m); HM: Washizawa-cho (120 m); TR: Aoya (160 m); HK: Negata, Gansui-ji (100 m); IG: Misakubo-cho, Misakubo Dam (550 m);Misakubo-cho, Arimoto (500 m); Keta-gawa, Toyooka Dam (450 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); Misakubo-cho, Shirakura-gawa, (950 m); Sakuma-cho, Urakawa (560 m); Asaba-cho, Moroi (10 m); SY: Haruno-cho, Ryûtô-san (1250 m); Haruno-cho, Hirano (150 m); Haruno-cho, Ishikiri (300 m); Haruno-cho, Moriyama (300 m); KK: Higashiyama, Ookubo (220 m); Awaga-take (350 m); Takinoya (100 m); OG: Kikugawa-cho, Hansei (60 m); Kikugawa-cho, Rokugô (40 m); Kikugawa-cho,

Higashitomita (150 m); Hamaoka-cho, Shiobarashinden (20 m); HR: Kawane-cho, Oowada (160 m); Kanaya-cho, Fukuyô, Hakko-gawa (150 m); Sagara-cho, Megami-yama (80 m); Sagara-cho, Ogami-yama (40 m); Omaezaki-cho, Omaezaki (20 m); SI: Uami (250 m); Chiba-san (350 m); Ikumi, Futamata (280 m); FE: Sangenya (30 m); Yahata (50 m); SD: Okabe-cho, Takakusa-yama, Megurizawa (150 m); YZ: Obama (10 m); SK: Ikawa, Inuma (600 m); Umegashima, Shinden (720 m); Okusenmata (670 m); Kuchisakamoto (520 m); Hirano, Mafuji-yama (900 m); Kuji (80 m); Ashikubo, Yazawa (150 m); Ashikubo, Shikichi (130 m); Utsunoya (100 m); Ookuzure (40 m); Mochimune (40 m); Shizuhata-yama (50 m); Ooya (50 m); SZ: Shishihara (240 m); Okutsu, Itaizawa (200 m); Taru-tôge (400 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); Shibakawa-cho, Kamiinako, Miyaji (160 m); IH: Yui-cho, Hamaishi-dake (200 m); Fujikawa-cho, Saginota (300 m); FM: Tanuki-ko (680 m); FJ: Imaizumi (40 m); ST: Oyama-cho, Suganuma (360 m); Nagaizumi-cho, Shimonagakubo (80 m); Nagaizumi-cho, Ashitaka-yama, upper stream of Momozawa-gawa (520 m); GT: Ninooka, Ninooka-jinja (500 m); SN: Chabatake (200 m); NZ: Oooka (10 m); Wakamatsu-zaki (20 m); TG: Kannami-cho, Hirai (50 m); Toi-cho, Odoi (20 m); Amagiyugashima-cho, Toi-gawa (380 m); Amagiyugashima-cho, Yugashima (480 m); Amagiyugashima-cho, Yoichizaka (240 m); Kayano (480 m); Nakaizu-cho, Shimoshiraiwa (100 m); KM: Kamo-mura, Arari (40 m); Kamo-mura, Ugusu (10 m); Kamo-mura, Ukusu-gawa (250 m); Nekko-tôge (950 m); Matsuzaki-cho, Jaishi-tôge (300 m); Minamiizu-cho, Jaishi (400 m); Minamiizu-cho, Iruma (10 m); Minamiizu-cho, Shimogamo (10 m); Kawazu-cho, west of Noborio (550 m); Kawazu-cho, Hama (10 m); Kawazu-cho, Sakashita (220 m); Kawazu-cho, Tanaka (10 m); Kawazu-cho, Mine (100 m); SM: Tsumeki-zaki (5 m); Shirahama (10 m); Tôji (5 m); Kisami (20 m); AT: Midorigaoka-cho (220 m); Hatsushima (20 m); IT: Akazawa (40 m); Tôtari (100 m)

Satsuma japonica carinata (PILSBRY & GULICK, 1902)
IN: Inasa-cho, Nishishimura, Nakamura (70 m); Inasa-cho, Higashishimura (90 m); HM: Takizawa (200 m)

Satsuma fausta (PILSBRY, 1902)
SK: Umegashima, Sakasa-gawa (1120 m); Kuchisakamoto (550 m); ST: Oyama-cho, Nakajima (500 m); TG: Amagiyugashima-cho, Kayano (480 m)

Satsuma sp.
IG: Sakuma-cho, Urakawa, Okuyama-gawa (560 m); Misakubo-cho, Shirakura-gawa (950 m); Misakubo-cho, Aokuzure-tôge (1000 m); Misakubo-cho, Misakubo Dam (530 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m); Misakubo-cho, Kadoketa (550 m); SY: Haruno-cho, Toyooka, Myojinkyo (400 m); Haruno-cho, Moriyama (300 m); Haruno-cho, Ishikiri (300 m); SD: Okabe-cho, Takakusa-yama (100 m); YZ: Ogama (10 m); SK: Ookuzure (40 m); Utsunoya (100 m); Funakawa (220 m)

This species resembles *Satsuma fausta* but differs in the following characters: (1) larger shell size, (2) shell conical. As detailed information on genital system is lacking, we tentatively treat it as an undescribed species.

Nipponochloritis fragilis (GUDE, 1900)
SY: Haruno-cho, Ishikiri (300 m)

Nipponochloritis oscitans (MARTENS, 1885)
SI: Chiba (200 m); SK: Umegashima, Kuchisakamoto (550 m); Do, Shirasawa (240 m); Okusenmata (670 m); Shizuhata-yama (110 m); SZ: Shishihara (240 m); IH: Yui-cho, Kagiana (200 m); ST: Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa (520 m)

Nipponochloritis pumila (GUDE, 1902)
IN: Inasa-cho Hlgashikurumegi (120 m); IG: Sakuma-cho, Sakuma Dam (260 m); Misakubo-cho, Aokuzure-tôge (1000 m); Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Shirakura-gawa, (950 m); Misakubo-cho, Nakanoone-yama (2300 m); Misakubo-cho, Yamzumi, Shiraiwa-zawa (1100 m); SY: Haruno-cho, Toyooka, Myôjinkyô (400 m); Haruno-cho, Moriyama (300 m); KK: Takinoya (100 m); OG: Daitô-cho, Iriyamase (100 m); Kikugawa-cho, Hotta (40 m); Kikugawa-cho, Hansei (60 m); FE: Yahata (50 m); SK: Umegashima, Sakasa-gawa (1120 m); Abe-tôge (1450 m); Kuchisakamoto (550 m); Ooya (50 m); FG: Shibakawa-cho, Kamiinako, Iriyama (350 m); FM: Fuji-san, Shiratsuka-rindo (1350 m); GT: Ninooka, Ninooka-jinja (500 m); TG: Kannami-cho, Karuizawa (350 m); Amagiyugashima-cho, Yugashima, Yoichizaka (240 m); KM: Kamomura, Arari (10 m); Kamo-mura, Nishina-tôge (600 m); Kawazu-cho, west of Noborio (550 m); Kawazu-cho, Hama (10 m)

Superfamily Helicacea

Family Bradybaenidae

Aegista proba minula (PILSBRY, 1901)
IN: Hosoe-cho, Ime (10 m)

Aegista proba goniosoma (PILSBRY & HIRASE, 1904)
SY: Haruno-cho, Kyômaru-zawa (460 m); SK: Ookuzure (10 m); Mochimune (40 m); IH: Yui-cho, Satta-tôge (200 m)

Aegista proba mikuriyensis (PILSBRY, 1902)
IN: Hosoe-cho, Ime (10 m): KS: Utsuyama (10 m); HM: Kanzanji (20 m); IG: Misakubo-cho, Shirakura-gawa (950 m); Yamazumi, Shiraiwa-zawa (1050 m); Arimoto (500 m); Kadoketa (350 m); IW: Iwai, Tsuruga-ike (10 m); KK: Oono, Nakagumi (80 m); OG Kikugawa-cho, Hotta (40 m); HB: Honkawane-cho, Fujikawa (400 m); Kawane-cho,

Shiomoto (180 m); Kanaya-cho, Hukuyô, Hakko-gawa (150 m); SK: Okusenmata (630 m); Kuchisakamoto (50 m) Do, Shirasawa (320 m); Yunoshima (260 m), Ashikubo, Sikichi (130 m); Ooya (20 m), Kunô (30 m); SZ: Taru-tôge (400 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); ST: Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa (520 m); GT: Fuji-san, north of Katabokkuri-yama (1400 m)

Aegista sp.
SK: Ikawa, en route from Nikengoya to Dentsuku-tôge (1600–2000 m); Umegashima, en route from Abe-tôge to Hakkôrei (1650 m); Abe-tôge (1450 m)
This species resembles *Aegista proba minula*, but differs in having weak keel on the periphery of whorls and in thin small shell (9.3–9.4 mm in diameter).

Aegista vulgivaga (SCHMACKER & BOETTGER, 1890)
IN: Inasa-cho, Tokka (200 m); Inasa-cho, Mitake (280 m); Inasa-cho, Tabata Ryûgashi-dô (80 m); Inasa-cho, Higashishimura (90 m); Inasa-cho, Tanishita (60 m); IG: Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Arimoto (500 m); Misakubo-cho, Yamszumi, Shiraiwa-zawa (1050 m); TR: Aoya (160 m); Tsuki (90 m); HK: Negata Gansui-ji (60 m); HM: Takizawa (200 m); SY: Haruno-cho, Moriyama (300 m); Haruno-cho, Ishikiri (300 m); Mori-machi, Ichinomiya (80 m); KK: Haranoya, Hatakama (50 m); Takinoya (100 m); OG: Kikugawa-cho, Rokugo (40 m); SI: Ikumi, Futamata (280 m); HB: Kanaya-cho, Fukuyo, Hakko-gawa (150 m); Sagara-cho, Megami-yama (80 m); Sagara-cho, Ogami-yama (40 m); FE: Kurata, Utôgeno-taki (420 m); SD: Okabe-cho, Megurizawa (150 m); SK: Okusenmata (670 m); Kuzureno, Yakusa (620 m); Kuchisakamoto (520 m); Ashikubo, Kurishima (150 m); Utsunoya (100 m); Sekibe (10 m); Gôjima (140 m); IH: Yui-cho, Kagiana (200 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); FM: Yamamiya (650 m); SN: Jûrigi (900 m); ST: Nagaizumi-cho, Ashitaka-yama, Momozawa-gawa (520 m)

Aegista inexpectata KURODA & MINATO, 1977
TR: Futamata (100 m; Kuroda & Minato, 1977)

Lepidopisum verrucosum (REINHARDT, 1877)
SM: Shirahama (10 m)

Trishoplita conospira (PFEIFFER, 1851)
KS: Shirasuka, Shiomizaka (10 m); IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Tanishita (60 m); IG: Sakuma-cho, Ryûtô-san (1250 m); Misakubo-cho, Yamazumi Shiraiwazawa (1100 m); TR: Kamiztago (120 m); Kannon-yama (500 m); Aoya (160 m); Funagira (50 m); HK: Negata, Gansui-ji (100 m); SY: Haruno-cho, Ishikiri (300 m); FR: Yamamoto (50 m); KK: Haranoya, Hatakama (50 m); Takinoya (100 m); Oono, Nakagumi (80 m); Higashiyama, Ookubo (220 m); Awaga-take (480 m); OG: Kikugawa-cho,

Hotta (40 m); Kikugawa-cho, Hansei (40 m); Kikugawa-cho, Rokugo (40 m); HB: Kawane-cho, Shiomoto (180 m); Sagara-cho, Megami-yama (80 m); Sagara-cho, Ogamiyama (40 m); SI: Uami (250 m); Chiba (200 m); YZ: Obama (10 m); SD: Okabe-cho, Takakusa-yama (150 m); SK: Ikawa, Kanzô (550 m); Okusenmata (670 m); Kuchisenmata (550 m); Ashikubo, Kurishima (150 m); Shizuhata-yama (50 m); Sekibe (10 m); Ookuzure (40 m); Mochimune (40 m); Ooya (50 m); Furuyado (30 m); SZ: Oodaira, Sorasawa (500 m); Tashiro-tôge (750 m); FG: Shibakawa-cho Kamiinako Iriyama (350 m); FM: Yamamiya (650 m); SN: Jûrigi (900 m); Chabatake (300 m); TG: Toi-cho, Odoi (20 m); Toi-cho, Koshimoda (40 m); KM: Kamo-mura, Ugusu, Kogane-zaki (10 m); Matsuzaki-cho, Yakiyama (60 m); Minamiizu-cho Iruma (10 m); Minamiizu-cho Irô-zaki (20 m); Kawazu-cho Hama (10 m); Kawazu-cho, Mine (100 m); SM: Kisami (10 m); Tsumekizaki (5 m); Shirahama (10 m); AT: Hatsu-shima

Trishoplita hilgendorfi tenuis PILSBRY, 1902
IN: Inasa-cho, Tokka (200 m); Inasa-cho, Higashishimura (100 m); HM: Takizawa (200 m); Washizawa-cho (120 m)

Euhadra senckenbergiana (KOBELT, 1875) Fig. 11
IG: Misakubo-cho, Misakubo Dam (550 m); Yamazumi, Shiraiwa-zawa (1050 m)

Euhadra eoa (CROSSE, 1868) Fig. 11
KS: Shirasuka Shiomizaka (10 m); Utsuyama (10 m); Bôze (60 m); Oota (20 m); IN: Mikkabi-cho, Tadaki (60 m); Inasa-cho, Tokka (200 m); Inasa-cho, Mitake (280 m); Inasa-cho, Tabata, Ryûgashi-dô (80 m); Inasa-cho, Nishishimura, Nakamura (70 m); Inasa-cho, Higashishimura (100 m); IG: Misakubo-cho, Yamazumi, Shiraiwa-zawa (1050 m); Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Arimoto (500 m); Misakubo-cho, Kadoketa (550 m); Asaba-cho, Yawata (10 m); TR: Aoya (160 m); Tsuki (90 m); HK: Negata, Gansui-ji (60 m); HM: Takizawa (200 m); Washizawa-cho (120 m); Sôzu-cho (10 m); Kanzanji (20 m); Enshûhama (5 m); IW: Kamata (10 m); SY: Haruno-cho, Ryûtô-san (1250 m); Haruno-cho, Moriyama (300 m); Haruno-cho, Ishikiri (300 m); Mori-machi, Ichinomiya (80 m); KK: Haranoya, Hatakama (50 m); Takinoya (100 m); OG: Oosuka-cho, Oobuchi (10 m); Oosuka-cho, Ishizu (10 m); Ogasa-cho, Kurodake (10 m); Kikugawa-cho, Hotta (40 m); Kikugawa-cho, Hansei (60 m); Hamaoka-cho, Sakura (20 m); Hamaoka-cho, Shiobarashinden (20 m); HB: Omaezaki-cho, Omaezaki (20 m); Sagara-cho, Megami-yama (80 m); Sagara-cho, Ogami-yama (40 m); Ooigawa-cho, Shimokosugi (5 m); SI: Iroo (40 m); FE: Yahata (50 m); YZ: Hanazawa (250 m); Obama (10 m); SK: Kuchisakamoto (520 m); Ashikubo, Yazawa (130 m); Utsunoya (100 m); Makigaya (100 m); Oshika (10 m); Takamatsu (10 m); Udo-san (50 m); Ookuzure (10 m); Negoya (10 m); Furuyado (30 m); Kuno (10 m); SZ: Shishihara (240 m); IH: Yui-cho, Hamaishi-dake (200 m); Yui-cho, Oojiro (280 m); Fujikawa-cho, Saginota (300 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); Shibakawa-cho, Kamiinako, Miyaji

(160 m); FM: Kamisodeno, Kitahara (260 m); FJ: Suzukawa (20 m) SN: Chabatake (300 m); KM: Kawazu-cho, Mine (100 m)

Euhadra amaliae callizone (CROSSE, 1871) Fig. 11

IN: Mikkabi-cho, Tadaki (60 m); IG: Misakubo-cho, Misakubo Dam (550 m); Misakubo-cho, Yamazumi, Shiraiwa-zawa (1100 m); Misakubo-cho, Kadoketa (550 m); SK: Kuchisakamoto (550 m); Naishô (310 m); Domoto, Shiinoki-zawa (500 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); Shibakawa-cho, Kamiinako, Iriyama (350 m)

Euhadra peliomphala peliomaphala (PFEIFFER, 1850) Fig. 11

SK: Ikawa, Nikengoya, Jaga-sawa (1500 m); Ikawa-tôge (1650 m); Umegashima, en route form Abe-tôge to Hakkôrei (1700 m); Ooya-kuzure (1900 m); FM: Chôjaga-take, (860 m); Kamiide (500 m); ST: Oyama-cho, Nakjima (500 m); TG: Kannami-cho, Karuizawa (350 m); south of Yugawara-tôge (800 m); AT: Midorigaoka-cho (220 m)

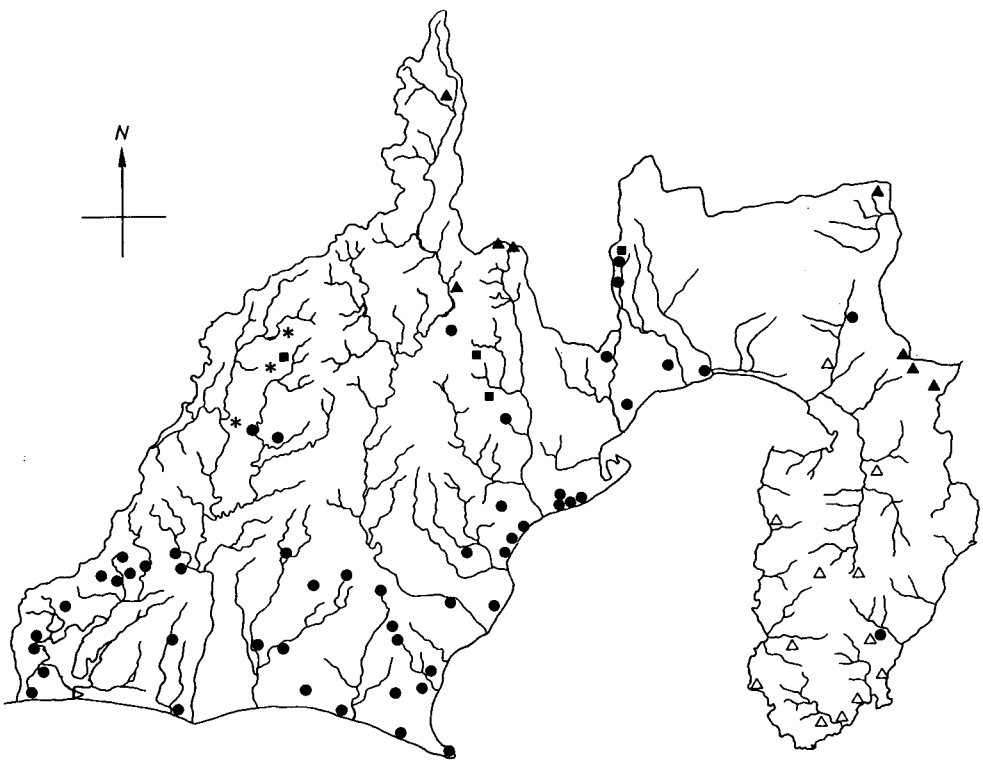

Fig. 11. Distributions of dextral *Euhadra* (Bradybaenidae): ●, *Euhadra eoa*; ▲, *E. peliomphala peliomphala*; △, *E. p. simodae*; ■, *E. amaliae callisona*; *, *E. senckenbergiana*.

Euhadra peliomphala simodae (JAY, 1856) Fig. 11

ST: Nagaizumi-cho, Shimonagakubo (80 m); TG: Toi-cho, Odoi (20 m); Amagiyugashima-cho, Yugashima, Yoichizawa (240 m); Nakaizu-cho, Shimoshiraiwa (100 m); KM: Matsuzaki-cho, Yakiyama (60 m); Minamiizu-cho, Shimogamo (10 m); Koura (10 m); Kawazu-cho, Sakashita (220 m); Mine (100 m); SM: Shirahama (10 m); Tsumeki-zaki (5 m); Kisami (20 m); Tôji (5 m); NZ: Wakamatsu-zaki (20 m)

Euhadra quaesita (DESHAYES, 1850) Fig. 12

SK: Umegashima, Abe-tôge (1450 m); SZ; Tashiro-tôge (750 m); Taru-tôge (400 m); FG: Shibakawa-cho, Kamiinako, Ochiai (260 m); Shibakawa-cho, Kamiinako Miyaji (160 m); NZ: Wakamatsu-zaki (20 m); ST: Oyama-cho, Subashiri-tozandô, Kyûmagaeshi (1350 m); Nagaizumi-cho, Ashitaka-yama, Momoyama-zawa (520 m); FM: Yamamiya (650 m); FJ: Ashitaka-yama, Sudo-gawa (750 m); Fuji-san, Katabokkuri-yama (1400 m); SN: Kojiri-tôge (820 m); Chabatake (300 m) TG: Kannami-cho Yugawara-tôge (800 m); Toi-cho, Odoi (20 m); Amagiyugahsima-cho, Yugashima, Kayano (480 m); Amagiyugahsima-cho, Amagi-tôge (650 m); KM: Kamo-mura, Nishina-tôge (600 m); Nekko-tôge (990 m); Kamo-mura, Ugusu Kanda (250 m); Kamo-mura, Ugusu, Kogane-zaki (10

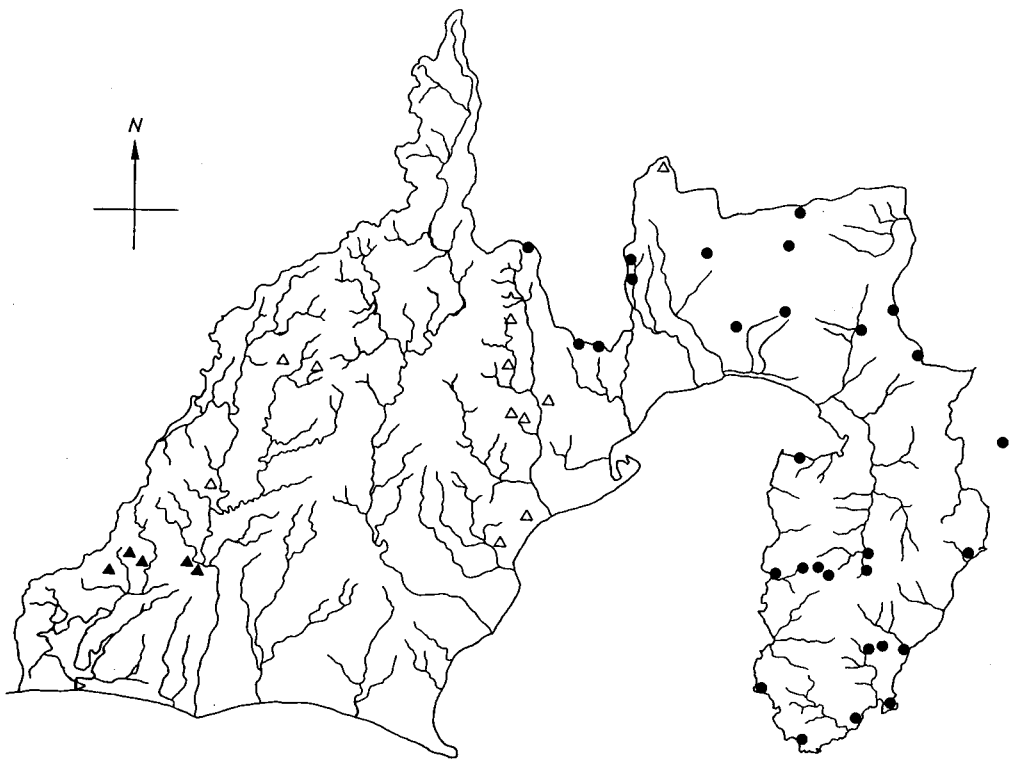

Fig. 12. Distributions of sinistral *Euhadra* (Bradybaenidae): ●, *Euhadra quaesita*; △, *E. scaevola*; ▲, *E. s. mikawa*.

m); Minamiizu-cho, Koura (10 m); Minamizu-cho, Iruma (10 m); Kawazu-cho, Sakashita (220 m); Kawazu-cho, Hama (10 m); Kawazu-cho, Mine (100 m); SM: Tôji (5 m); Tsumeki-zaki (20 m); AT: Hatsu-shima (20 m); IT: Totarî (100 m)

Euhadra scaevola scaevola (MARTENS, 1877) Fig. 12
IG: Misakubo-cho. Yamazumi, Shiraiwa-zawa (1050 m); Tatsuyama-mura, Ichinose (320 m); SY: Haruno-cho, Kyômaru-zawa (460 m); SI: Chiba-san (360 m); SD: Okabe-cho, Megurizawa (150 m); SK: Umegashima, Okusenmata (670 m); Nagakuma, Nunomaki-zawa (100 m); Ashikubo, Yazawa (170 m); Ashikubo, Shikichi (150 m); Kuzureno, Yakusa (620 m); Ryûsô-zan, Hozumi-jinja (700 m); FM: Nebara (1000 m)

Euhadra scaevola mikawa AMANO, 1939 Fig. 12
IN: Inasa-cho, Tokka (200 m); Inasa-cho, Tabata, Ryûgashi-dô (80 m); TR: Aoya (160 m); Isuka (120 m); HK: Negata, Gansui-ji (60 m); HM: Washizawacho (120 m); Takizawa (200 m)

Bradybaena similaris (FÉRUSSAC, 1831)
KS: Shirasuka, Shiomizaka (10 m) ; IN: Inasa-cho, Higashishimura (100 m); HM: Sanshincho (5 m); HK: Negata, Gansui-ji (60 m); IW: Kamata (10 m); OG: Oosuka-cho, Oobuchi (10 m); Daitô-cho, Chihama (10 m); Kikugawa-cho, Hansei (60 m); Kikugawa-cho, shimohansei (40 m); Hamaoka-cho, Sakura (20 m); SI: Uami (250 m); Iroo (40 m); HB: Omaezaki-cho, Omaezaki (10 m); Haibara-cho, Kashima (5 m); SK: Ooya (50 m); FJ: Suzukawa, Ukishima-numa (5 m); NZ: Oooka, Kise-gawa (10 m); SM: Shirahama (10 m); AT: Hatsushima (20 m);

Phaeohelix miyakejimana (PILSBRY & HIRASE, 1903)
AT: Hatsu-shima (20 m)

Acusta despecta sieboldiana (PFEIFFER, 1850)
IN: Mikkabi-cho, Honzaka (200 m); Mikkabi-cho, Tadaki (60 m); Inasa-cho, Higashishimura (100 m); HM: Kanzanji (30 m); Murakushi (10 m); SY: Mori-machi, Ichinomiya (80 m); FR: Yamamoto (50 m); OG: Oosuka-cho, Oobuchi (10 m); Oosuka-cho, Ishizu (10 m); Kikugawa-cho, Hotta (40 m); Kikugawa-cho, Rokugô (40 m); Kikugawa-cho, Shimohansei (40 m); Hamaoka-cho, Sakura (20 m); HB: Omaezaki-cho, Omaezaki (20 m); Sagara-cho, Megami-yama (80 m); Sagara-cho, Ogami-yama (40 m); FE: Sangenya (30 m); SK: Utsunoya (100 m); Takamatsu (10 m); Ooya (10 m); SZ: Orido (10 m); FM: Myôjô-san (180 m); FJ: Suzukawa (20 m); Ukishima-numa (5 m); NZ: Oooka, Kise-gawa (10 m); TG: Toi-cho, Odoi (20 m); KM: Kamo-mura, UGusu, Koganezaki (10 m); SM: Shirahama (10 m)

Distribution Pattern and Guild Structure

The above list includes 111 species, among which 14 were Prosobranchia and 97 were Pulmonata including 22 Clausiliid and 5 *Euhadra* species. Species richness of each vertical mesh is shown in Table 1. The total munbers of land snail species in lower altitudes were generally larger than in higher altitudes, though species richness of some taxa such as Clasuiliidae were high at altitudes 500-1500 m for some longitudes. The malacofauna in subalipine coniferous foreset (altitudes > 2000 m) was strikingly poorer than at lower altitudes. In contrast with the altitudinal gradient in species richness, there were no obvious longitudinal gradient.

The data matrices of malacofauna among meshes were used fo principal component analysis (PCA) (Table 2). The major inter-mesh trend was mainly related to the variation in inhabitance of common species which are distributed widely (First principal component, PC1, 22.9% of variance). All variables had positive loads on PC1 and this trend refers to that of species richness. The second intermesh gradient involved variation in inhabitance of species which were confined only east or west meshes (PC2, 11.0%). Variables of species confined in east meshes had positive loads on PC1, and those in west subregions had negative ones. Thus, this gradient was longitudinal gradient. The third inter-mesh trend was related to veriation in inhabitance of species which are distributed in high (> 500 m) altitudes in mainland excluding Izu Peninsula (PC3, 9.7 %).

Distribution of malacofaunas in meshes over the plane defined by the PC1 and PC2 is shown in Fig. 13. The plots of the meshes of the same altitude but different longitudes line up vertically, suggesting that the malacofauna has a clear longiudinal gradient. The plots ot the meshes of differnt altitudes but the same longitude line up horizontally. In high altitudes (> 1500 m), however, the horizontal rows abruptly converge and the longitudinal gradient is extinguished.

The malacofauna in meshes were classified according to the composition of molluscan species (Fig. 14). Malacofauna in meshes at low altitudes formed a cluster, which has two discontinuities between C1 and D1 and between F1 and G1. Other meshes at high (> 500 m) altitude were clustered as three groups. First cluster involves the meshes of west part of the Akaishi Range (B2 and B3). The second and

Table 1. Numbers of species for Prosobranchia, Pulmonata, Clausiliidae, *Euhadra* (Bradybaenidae) and the totals of malacofauna.

Taxa	Meshes																						
	A1	B1	C1	D1	E1	F1	G1	B2	C2	D2	E2	F2	G2	B3	C3	D3	E3	F3	B4	C4	D4	E4	C5
PROSOBRANCHIA	10	9	6	7	7	5	8	6	6	7	6	6	4	1	4	6	6	5	0	1	1	0	0
PULMONATA	44	43	39	42	30	30	42	35	13	34	22	29	15	29	12	25	21	16	2	3	7	1	2
Clausiliidae	7	9	6	8	4	3	6	6	3	8	7	8	1	6	3	7	7	3	0	1	2	0	0
Euhadra	3	1	1	3	3	2	4	4	1	5	0	2	1	3	0	2	1	2	0	1	1	0	0
Total	54	52	45	49	37	35	50	41	19	41	28	35	19	30	16	31	27	21	2	3	8	2	2

third clusters refer to the meshes of the central part of the Akaishi Range and the Mt. Fuji Region except for D3.

Table 2. Principal component analysis of the data on distribution among meshes. Only loadings > 0.150 for PC1, > 0.110 for PC2 and > 0.150 for PC3 are shown.

Variables	Factor loading		
	PC1	PC2	PC3
Georissa japonica	···	-0.113	···
G. shikokuensis	···	-0.124	···
Nakadaella micron	···	···	0.163
Palania pusilla	···	···	0.163
Diplommatina labiosa	···	···	0.215
D. uzenensis	···	···	0.215
D. oyamai	···	0.210	···
Paludinella japonica	···	0.210	···
Carychium noduliferum	···	···	0.243
Bensonella plicidens	···	-0.124	···
Minus reinianus	0.166	···	···
Zaptychopsis buschi	···	0.168	···
Tyrannophadeusa aurantiaca erberi	···	-0.147	···
T. surugensis	···	0.186	···
Mundiphaedusa hosoyaka	···	-0.115	···
Vitriphaedusa micropeas	···	···	0.208
Megalophaedusa martensii	···	-0.111	···
Reinia variegata	···	0.210	-0.155
Pictophaedusa euholostoma	···	0.210	-0.155
Sinoennea iwakawa	0.166	···	···
Trochochlamys praealta	0.156	···	···
T. subcrenata	0.166	···	···
Sitalina circumcincta	0.176	···	···
Parasitara nanodes	0.158	···	···
P. reinhardti	0.169	···	···
Nipponochlamys semisericata	···	···	0.204
Satsuna moellendorfiana m.	···	0.818	···
S. m. thaamuni	···	···	0.156
S. japonica	0.155	···	···
S. sp.	···	0.189	···
Trishoplita conospira	0.172	···	···
Euhadra peliomphala	···	0.166	···
E. p. simodae	···	0.210	···
E. eoa	0.177	···	···
Bradybaena similaris	0.167	···	···
Phaeohelix miyakejimana	···	0.210	···
Acusta despecta sieboldiana	0.167	···	···
Cumulative proportion of variance (%)	22.9	33.9	43.6

Next, we investigate the inter-species pattern of distribution. Fig. 15 shows vertical and longitudinal distributions pattern of 5 Prosobranch species. *Waldemaria japonica* and *Cyclophorus herklotsi* inhabited the mainland excluding Izu Peninsula whereas the former did only at higher altitudes and the latter at lower altitudes. *Japonia sadoensis* distributed throughout Shizuoka Prefecture below 1000 m in altitude while *J. katorii* was confined in the west subregion. *Nakadaella micron* was widely distributed in meshes below 1500 m in altitude. Thus, each species has characteristic distribution pattern.

PCA was performed on the data for distribution of molluscan species over meshes (Table 3). The major interspecific trend involved variation in range of distribution (PC1, 26.1 %). All variables had positive loads on PC1. In contrast, variables for malacofauna of higher ($>$ 500 m) and lower ($<$ 500 m) altitudes had positive and negative loads on PC2, respectively. Thus, the second gradient was altitudinal gradient. The third trend involved variation in B4 and C5, and the fourth one in D4 and E4. The fifth gradient was mainly related to variation in F1, G1, B2, F2, B3 and C3. The variables F1, G1 and F2 had positive loads whereas B2, B3 and C3 had negative ones on PC5. This gradient appears to be longitudinal one.

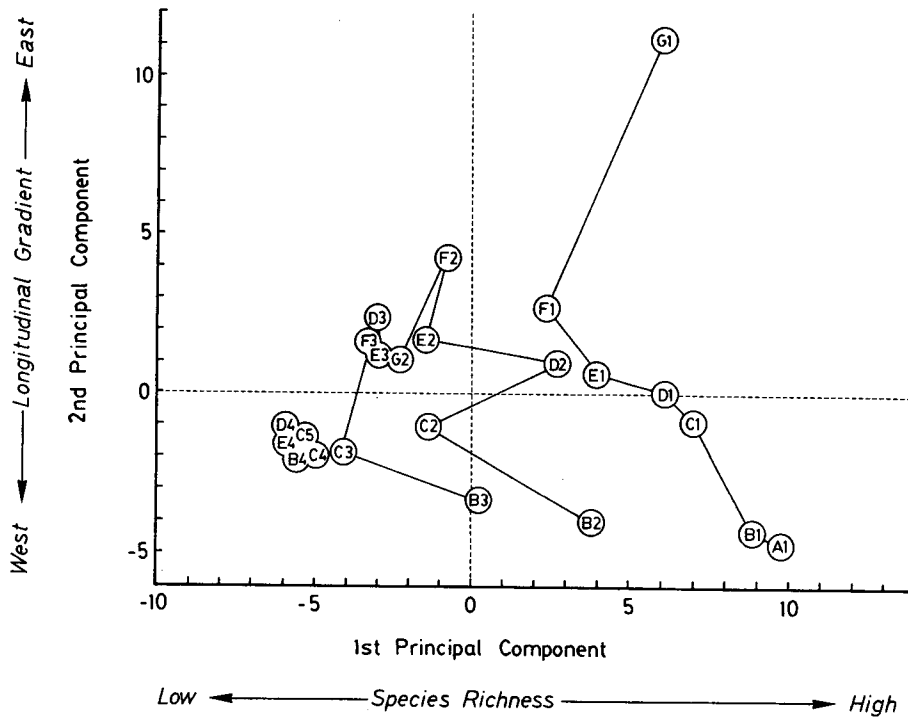

Fig. 13. Distributions of malacofauna in meshes over the plane defined by the first and second principal components (Table 2) resulting from the correlation matrix for variables of malacofauna (N = 23 meshes). Directions of increase of variables associated with each gradient are shown by arrows at margins of the graph.

Fig. 16 shows the distribution of species over the plane defined by PC1 and PC2. The plots of 5 prosobranchia species which had different distribution patterns (Fig. 15) were scattered widely. Plots of clausiliid taxa (species and subspecies) were also scattered widely, whereas some plots were aggregated on the lefthand. The clausiliid species inhabiting lower altitudes had more limited distributions than those inhabiting higher alititudes, and there were no clausillid species which had such a wide distribution (PC1 $>$ 0.50) as *Makadaella micron* (Cyclophoridae), *Chamalycaeus nipponensis* (Alycaeidae), *Diplommatina labiosa* (Diplomatinidae), *D. uzenensis* (ditto), *Trochoclamys fraterna* (Helicarionidae) and *Discoconulus sinapidium* (ditto).

To elucidate the effect of interspecific interaction on the molluscan distribution pattern, shell height and shell volume of sympatric and allopatric clausiliid species were compared (Fig. 17). The volume of the largest species, *Megalophaedusa martensii*, was 130 times larger than that of the smallest species *Vitriphaedusa micropeas*. The log volumes of sympatric species were usually differnt each other. The log volume varied among populations within a species. The volume of *Vastina hickonis hickonis* in B3 was 1.8 times larger than that of *V. h. mikawa* in A1. The volume of *Mundiphaedusa dorcas* in D3 was 2.26 times larger than that in D2. These examples

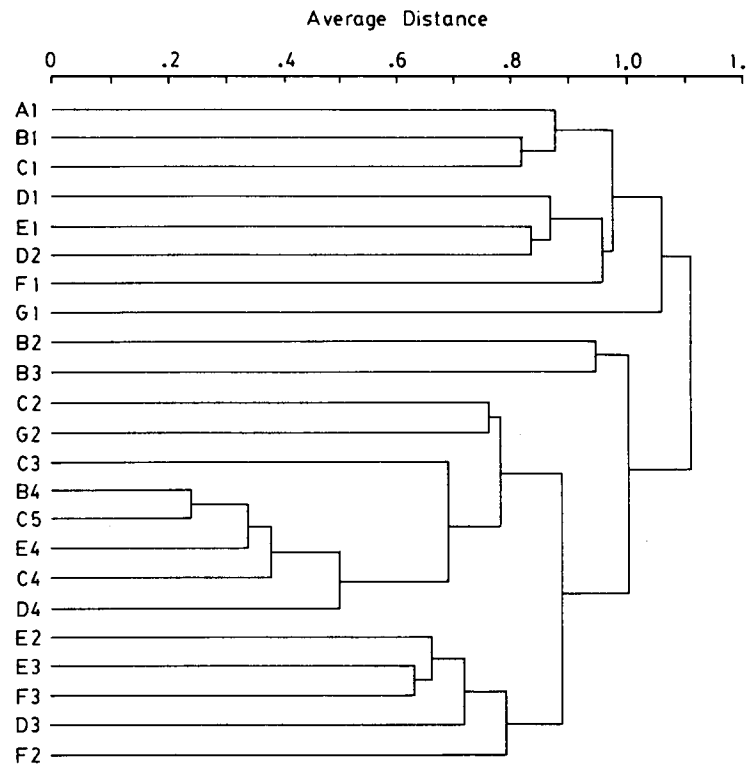

Fig. 14. Classification of malacofauna in meshes according to the composition of molluscan species.

show individuals in populations at higher altitudes are larger than those at lower altitudes. There were, however, inverse gradients. The volume of *Megalophaedusa martensii* in C1 was 1.6 times larger than that in D2. *Stereophaedusa japonica* has a more complex variation. The volume of *S. j. japonica* in C1 was 1.2 times larger than that in B3, and the volume of *S. j. oostoma* in D1 was 0.50 times smaller than that in D3, whereas the volume *S. j. japonica* in B3 was 1.9 times larger than that of *S. j. oostoma* in D3. These pattern of variation independent of altitudes may suggest that the size of clausiliid snails is influenced by interaction with other sympatric species. The interspecific interaction may be demonstrated by the fact that the character displacement pattern in shell volume was roughly similar among meshes though the species compositions are substantially different among them.

Discussion

Generally, there are three abiotic environemntal gradients, i.e., altitudinal, longi-

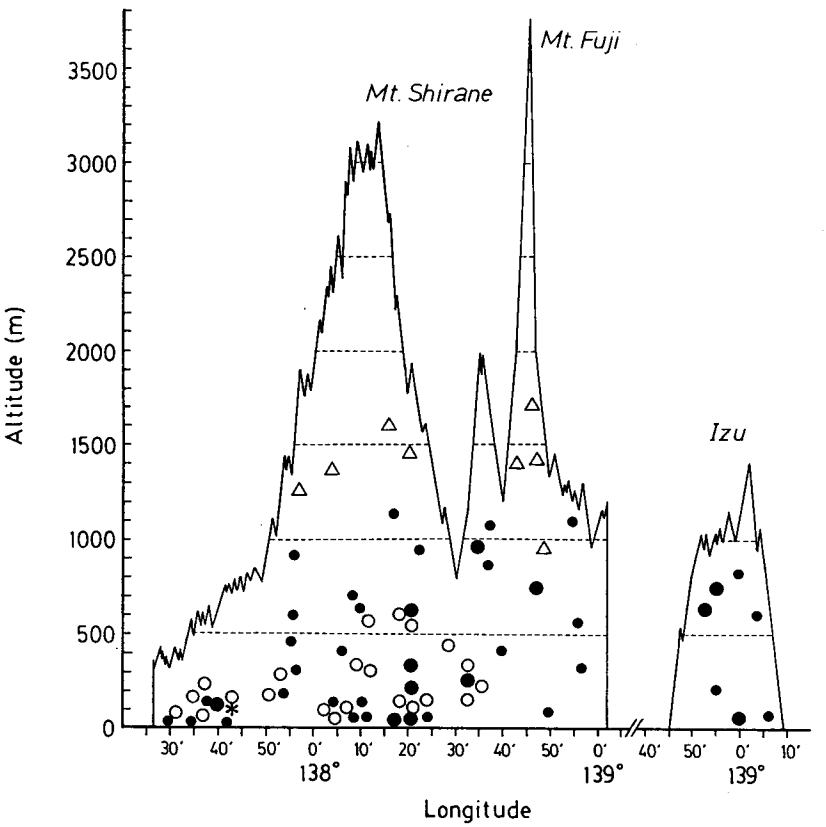

Fig. 15. Distributions of 5 Prosobranch species over vertical meshes:
△, *Waldemaria japonica*; ●, *Japonia sadoensis*; ＊, *J. katorii*;
○, *Cyclophorus herklotsi*; ・, *Nakadaella micron*.

Table 3. Principal component analysis of the data on distribution of molluscan species over meshes. Only loadings > 0.15 were shown.

Variables	Factor loading				
	PC1	PC2	PC3	PC4	PC5
A1	0.217	-0.277	···	···	···
B1	0.210	-0.316	···	···	-0.168
C1	0.205	-0.325	···	0.200	···
D1	0.243	-0.168	···	···	···
E1	0.270	-0.210	···	···	···
F1	0.236	···	-0.240	0.187	0.240
G1	0.155	···	···	···	0.493
B2	0.229	···	-0.152	···	-0.414
C2	0.269	···	···	···	-0.176
D2	0.289	···	···	···	···
E2	0.288	0.176	···	-0.181	···
F2	0.260	0.217	···	-0.226	0.204
G2	0.246	···	···	-0.158	···
B3	0.151	···	···	···	-0.420
C3	0.160	0.192	···	···	-0369
D3	0.217	0.375	···	0.158	···
E3	0.242	0.300	-0.167	···	···
F3	0.258	0.247	···	···	···
B4	···	···	0.639	···	···
C4	···	0.213	···	···	···
D4	···	0.282	···	0.574	···
E4	···	0.211	···	0.573	···
C5	···	···	0.639	···	···
Cumulative proportion of variance (%)	26.1	39.6	47.6	54.1	59.7

tudinal and latitudinal gradients. Topography of Shizuoka prefecture sloping up to the north suggests that latitudinal gradient roughtly corresponds to altitudinal gradient excluding Izu peninsula. Thus, we analyzed the biogeography of molluscan fauna using vertical meshes partitioned by altitudinal and longitudinal axes and by the border between the mainland and Izu Peninsula. Principal component analysis on malacofaunas of meshes suggested that there were clear altitudinal and longitudinal gradients among these malacofaunas.

As altitude increased, the species richness of malacofauna decreased and the composition of malacofauna changed. Abrupt decrease in species diversity occurred at about 1500 m in altitude, where vegetation shifted from cool temperate deciduous forest to sub-alpine coniferous forest. These changes of diversity may be due to changes of characters of the litter and soil and associated vegetation (Cameron, 1986). Some species inhabit only specific microhabitats; for example, mossy floors of primary beech forests (e.g. *Vitriphaedusa micropeas*), around limestone outcrops in the forests (e.g., *Aegista inexpectata*) and interstitial zone of graveled slopes covered with sedge.

The last microhabitat distributed from Kantô district to Kyûshû district at altitudes of 150 - 1300 m fosters *Neophaedusa iijimakuniaki* in Shizuoka Prefecture, *N. yagurai* in Kantô District, *N. pachyspira* in Kii Peninsula, *N. Akiratadai* in Shikoku Island and *N. albela* in Kyûshû Island.

In contrast with altitudinal gradient, longitudinal gradient is not ecological gradient, and accordingly is vague for organisms which have high potential for dispersal. The longitudinal gradient of malacofauna is thought to arise in three manners. First, the limited distribution of limestone beds in west subregions in Shizuoka Prefecture determine the distribution of those calciphilous molluscs such as *Georissa shikokuensis, Japonia katorii, Bensonella plicidens, Aegista inexpenctata, Trishoplita hirgendorfi tenuis*

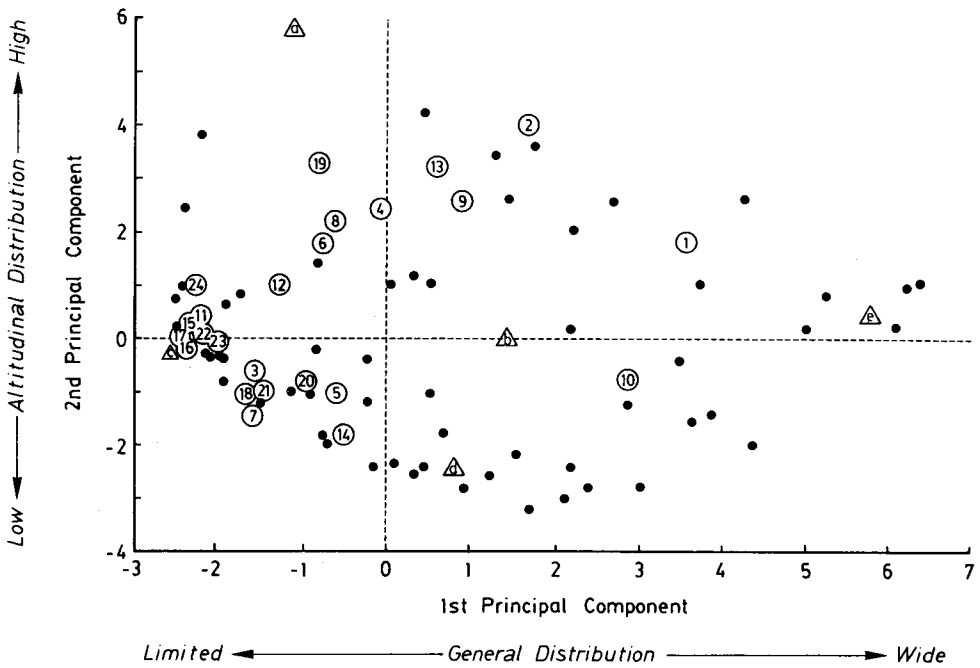

Fig. 16. Distribution of molluscan species over the plane defined by the first and second factors (Table 3) resulting from the correlation matrix for variables of distribution. Directions of increase of variables associated with each gradient are shown by arrows at margins of the graph. Opne circles and triangles denote species of Clausiliidae and Prosobranchia, respectively: 1, *Zaptychopsis buschi*: 2, *Pinguiphaedusa pinguis platydera* ; 3, *P. p. platyauchen* ; 4, *P. hakonensis* ; 5, *Tyrannophaedusa aurantiaca erberi* ; 6, *T. surugensis* ; 7, *Mundiphaedusa hosoyaka* ; 8, *M. rex* ; 9, *M. dorcas* ; 10, *M. rhopalia* ; 11, *M. sericina* ; 12, *Neophaeusa iijimakuniakii* ; 13, *Vitriphaedusa micropeas* ; 14, *Megalophaedusa martensii* ; 15, *Vastina hickonis* ; 16, *V. h. mikawa* ; 17, *V. ikenoi* ; 18, *Stereophaedusa japonica japonica* ; 19, *S. j. oostoma*, 20, *S. gouldi* ; 21, *Euphaedusa tau* ; 22, *Phaedusa sieboldii* ; 23, *Reinia variegata* ; 24, *Pictophaedusa euholostoma* ; a, *Waldemaria japonica* ; b, *Japonia sadoensis* ; c, *J. katorii* ; d, *Cyclophorus herklotsi* ; e, *Nakadaella micron*.

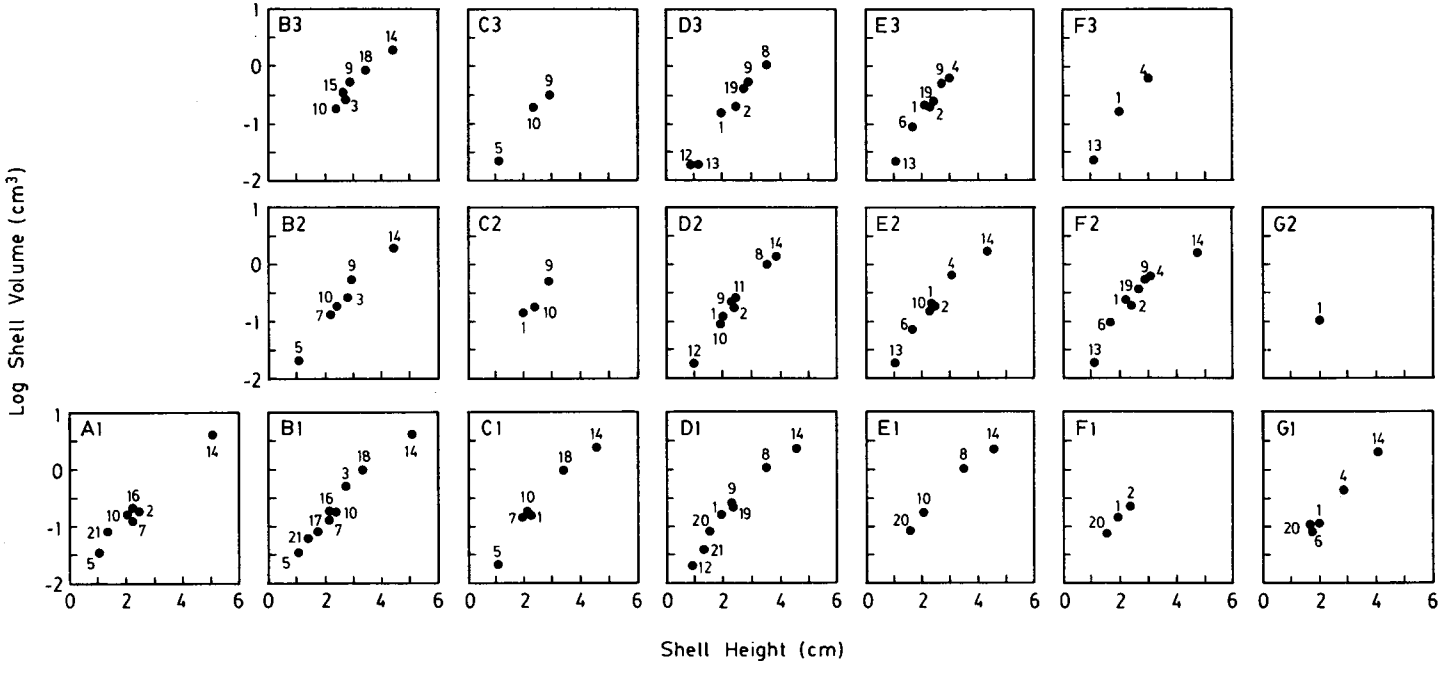

Fig. 17. Log volume of shell body of sympatric clausiliid species in each vertical mesh. Numbers in the graphs denote the species codes in Fig. 16.

and *Euhadra scaevola mikawa*.

Second, geographical barriers for dispersal cause limited destribution. The fact that the longitudinal gradient was clearer at lower altitudes than at higher alititudes (Fig. 13) suggests that the ranges of molluscan species inhabiting substrata other than limestone at lower altitudes are incessantly moveing along longitude or that the spreads of their ranges are obstructed or slowed down by barriers such as big rivers. Ishikawa (1966) reported that flightless carabid beetles inhabiting lowland, *Apotomopterus esakii, A. insulicola komiyai* and *A. i. arrowinanus* are distributed parapatrically separated by Ooi and Tenryû Rivers. We found similar examples in lowland clausiliid snails; for example, *Vastina hickonis mikawa* has not crossed Tenryû River to east bank excluding upper stream, and *Stereophaedusa gouldi* not Abe River to west bank. *Mundiphaedusa hosoyaka*, however, has crossed Ooi River to east bank at middle stream. The front lines of the ranges of these species are probably moving slowly, but its advancing may be also hindered or slowed down by interspecific competition. The destruction of habitats by man is another impassable barriers.

Third, the history of isolation and speciation is related with the limited distributions. As Habe (1977) reported, the formation of the malacofauna of Izu Peninsula and the Izu Islands was related with geohistory. When Izu peninsula was isolated from mainland by activity of volacanos, many molluscan species became extinct and some species differentiated into new species. *Diplommatina oyamai, Tyranophaedusa surugensis, Pinguiphaedusa hakonensis, Satsuma moellendorffiana* and *Satsuma fausta* are thought to have their origins in this isolated 'island'. The species which are common in mainland, e.g., *Waldemaria japonica* and *Cyclophorus herklotsi*, have not invaded Izu Peninsula. In contrast, some species, e.g., *Phaedusa sieboldii, Reinia variegata* and *Phaenohelix miyakejimana*, have colonized Izu Peninsula or Izu Islands through overseas dispersal from southern islands. Other most molluscan fauna in Izu Peninsula seems to have invaded through the land bridge mainly from the east.

Finally, we discuss the effect of interspecific interaction on molluscan guild structure. Twenty-two Clausiliid species were recorded in Shizuoka Prefecture, and the maximum of 9 species were sympatric in a mesh. In each mesh, there were differences in body size among sympatric species. Though the composition of species was different among meshes, the interspecific variation pattern in the shell volume was similar among these meshes. Whether the differences are results of interspecific competition, requisites for reproductive isolation or requisites for coexistence is still unknown, because information on their reproduction is too incomplete (Tompa, 1984). The process of specialization and the guild structure of Clausiliidae contrast strikingly with those of *Cerion*, which has no reproductive isolation and shows only allopatric or parapatric distribution of species (Woodruff & Gould, 1980; 1987). An integrated study of phylogeny, functional morphology, guild structure, life-history and reproductive behavior of Clausiliidae and other land snails in wider geographical scale will elucidate the porcess of evolution and formation of the malacofauna.

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Addresses of the Authors :

(Mr) Makoto Kato, D. Agr. 加藤 真
Biological Laboratory, Yoshida College, Kyoto University 京都大学教養部生物学教室
Yoshida-Nihonmatsu-cho, Sakyo-ku, Kyoto, JAPAN 606. 京都市左京区吉田二本松町

(Mr) Masamichi Matsumoto 松本雅道
Kikugawa High-School, Tokoha-Gakuen 常葉学園菊川高等学校
Kikugawa-cho, Ogasa-gun, Shizuoka-ken, JAPAN 439 静岡県小笠郡菊川町

(Mr) Tôru Kato 加藤 徹
Hokuen Forestry Institute 北遠林業試験場
Kashima, Futamata-cho, Tenryû-shi, Shizuoka-ken, JAPAN 431 - 33 静岡県天竜市二俣町鹿島